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CIRCLING DISEASE OF SHEEP.

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CIRCLING disease of sheep is a condition in which there is an infectious inflammation of the animal's brain and its covering membranes. It is called "circling" because one of the principal symptoms shown is a tendency to turn in a circle either to the right or left. The main object of this article is to give sheep-farmers available information regarding the disease, and to correct mistaken but rather prevalent ideas as to its nature.

The disease has not been reported from the South Island, but is widely spread in the North Island, having been met with in the Wairarapa, Hawke's Bay, Taranaki (particularly the southern part), and the Waikato.

GENERAL DESCRIPTION.

The condition usually occurs from about February to May, during dry weather, and in most cases tends to disappear soon after a good rain has fallen. Odd cases occur at other times of the year, but are not very common. Hoggets and younger sheep are generally affected more than older animals, but even full-mouthed sheep are sometimes attacked. The loss is seldom serious, though sometimes 3 to 4 per cent. may die in the course of a few weeks. Affected sheep very rarely recover once symptoms are shown.

On farms where the shepherding is not very close affected animals are often found lying paralysed and only semi-conscious, but when the sheep are under close observation the course the disease takes is seen to last as a rule for three or four days. Affected animals at first are dull and, if driven, tend to bear off to the right or left. Later the head is held slightly tilted to one side. The animal then moves in a circle in the direction towards which its head is turned. The eye on that side tends to weep, and if the sheep is caught and examined it will generally be noticed that the eyeball itself is constantly twitching. As the disease progresses the animal becomes more sleepy and disinclined to move. If compelled to do so the circle in which it turns gradually becomes smaller, till in the later stages of the condition it can only stand with assistance, and if held up persistently

turns round on its own axis. A sheep which circles to the right never goes to the left, and *vice versa*; it will strongly resist every effort to make it do so. In the later stages there is usually some nasal discharge and dribbling of saliva from the mouth.

POPULAR THEORIES REGARDING THE DISEASE.

The symptoms that have just been described simply point to a disturbance of the brain, and such a disturbance, causing very similar symptoms, can result from more than one cause. It seems to be a fairly common belief among sheep-farmers who have experienced this disease that it is due either to "grub in the head," the larvæ of the sheep nostril fly, *Oestrus ovis*, which are commonly found in the cavities of the skull of sheep; or else to "gid" or "cyst on the brain," a particular variety of hydatid cyst, *Coenurus cerebralis*, which occurs on or in the brain of cattle and sheep and is the cystic stage of a dog tape-worm called *Taenia coenurus*.

The latter condition has certainly been met with in New Zealand, but is extremely rare. In the very many cases of circling disease which have been investigated, since inquiries were commenced in 1928, no cysts in the cranial cavity have ever been found. Any farmer who finds sheep with the symptoms outlined above can easily satisfy himself as to whether it is or is not "gid" by splitting open the skull and removing the two halves of the brain. The cysts which cause "gid" are like small bladders of watery fluid, varying in size from a pea to a hen's egg. One or more may be present, generally on the upper surface of the brain, and they could not easily be overlooked.

"Grub in the head" is very commonly seen in sheep that have never shown any symptoms whatever. The mature larvæ are generally found in the sinuses or cavities of the skull, situated above the eyes and communicating with the nasal passages. These cavities are separated from the brain by a layer of bone. The grubs or larvæ are about $\frac{1}{2}$ in. long and brownish in colour. The head is rather pointed and the tail more or less square-cut, with two black marks in it (the stigmal plates) that are often mistaken for eyes but in reality comprise part of the breathing apparatus. These are the "third-stage" larvæ of the sheep nostril fly, and in view of what will be said later it is as well to give here the main facts about the fly's life-history. It is on the wing during warm sunny days throughout the summer, but does not fly far afield, usually keeping fairly closely to the vicinity in which it is hatched. The female, which is rather larger than a house fly, brownish in colour, with a distinctly hairy body, flies very rapidly and darts at the nostrils of the sheep, where she deposits either living larvæ or eggs which very quickly hatch out. The larvæ crawl rapidly up into the animal's nasal passage. Sheep that are being attacked by the fly are apt to be very restless and will often run about in an effort to evade it. They frequently push their noses down on to the ground, either to keep their nostrils out of the fly's reach or to try to allay the irritation caused by the larvæ crawling along the nasal passages.

These first-stage larvæ are very small, well under $\frac{1}{10}$ in. long. After a long period of wandering about in the nasal passages and sinuses

of the head the larvæ develop into the second stage and finally into the third stage, the well-known "grub in the head." The mature larvæ leave the sheep about ten months after the eggs or first-stage larvæ were deposited in the nostrils. By migrating from the cavities of the skull into the nasal passages they set up irritation there, which is accompanied by nasal catarrh and sneezing. After being expelled, usually through sneezing, they quickly turn into pupæ, and about a month later the fly itself emerges from the pupa to commence the cycle over again. Thus the fly functions in the summer months; the first-stage larvæ are present in the nasal chambers, &c., of infested sheep in summer and early winter. The mature larvæ are to be found in the cavities mainly in the winter and spring, and during the spring and early summer they are mostly expelled. Since "circling disease" occurs, with few exceptions in the late summer and early winter, it is not likely to be the mature larvæ that are causing it, as they are not present to any extent at that period of the year.

There is certainly a possibility that the first-stage larvæ may play an important but indirect part in causing the disease, and this will be referred to again later.

RECENT RESEARCH WORK AT WALLACEVILLE.

Early in the investigation it was found that if one took certain portions of the brain and prepared sections from them that could be examined with a microscope quite definite lesions were present. Some of the small blood-vessels show abnormal collections of cells around them, and here and there in the sections may be seen small areas containing numerous pus cells (see Fig. 1). In some of these latter areas microbes are present (Fig. 2), and it has now been found possible



FIG. 1. MICROPHOTOGRAPH SHOWING LESIONS IN BRAIN OF AFFECTED SHEEP.

Right: Accumulation of pus cells. Left: Small blood-vessel with its wall packed with cells. The surrounding brain tissue also shows invasion with cells from the blood-vessel.

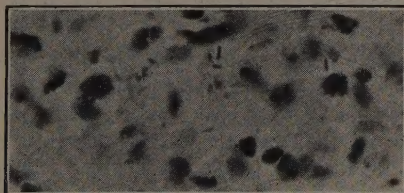


FIG. 2. ORGANISMS IN A LESION SIMILAR TO THAT SEEN ON THE RIGHT IN FIG. 1.

to grow them artificially in the laboratory. In all cases where the microbes could be seen with a microscope in the brain lesions they appeared to be of the same sort, and since we have discovered how best to set about growing them they have been isolated on several occasions in pure culture from the brains of affected sheep.

We cannot give the name of this organism here, as it appears to be a new variety, but it is definitely pathogenic (*i.e.*, capable of inducing disease) not only to sheep but also to rabbits. When it is injected into the ear vein of a rabbit the animal dies in a day or two and the microbe can be recovered from its body, where it is found to have caused severe lesions in the liver, and often, too, in the membranes covering the brain and spinal cord. When even large doses of the organism are injected into the veins of sheep they merely show a high degree of fever for a few days and then entirely recover, but if quite small doses are injected into the carotid artery, so that the injected organisms are carried more directly to the brain, the animal shows severe symptoms of brain disturbance in a few days. It dies in about a week, after going through a course of illness like that seen in natural cases of circling disease, and when the brain is examined lesions are found in it like those of the natural disease.

An interesting observation is that if a small dose of this organism is poured up the nostril of a sheep the animal will develop a very high temperature, followed in a day or two by symptoms of pneumonia, then by signs of inflammation of the brain, after which the animal dies. This has occurred in each of the only two sheep on which the experiment was tried. When the animals died it was found that the lungs were affected over large areas with pneumonic changes, and the organism in question could be grown from them. It was also found to be present in very large numbers in the brain, although the lesions found there on microscopical examination were not similar to those of naturally occurring circling disease.

DISCUSSION.

This very brief outline of the work that has been done in connection with the disease will serve to show that we have rather definite grounds for incriminating the organism referred to as the immediate cause of the brain lesions, of the symptoms shown by affected sheep, and of their death. That is certainly a step in the right direction, but in order to control or prevent the disease much more than this is required. In the first place, one must discover how the organism gains entrance to the sheep's body and by what path it reaches the brain. If it is conveyed from affected to healthy sheep one must discover how this happens before any rational steps can be taken to prevent it.

As was mentioned earlier there is a distinct possibility that the first-stage larvæ of the sheep nostril fly (*Oestrus ovis*) may play a part in setting up the disease, and a start has been made this season, as opportunity offers, to collect evidence which may support or refute the idea. One has the fact that sheep are very susceptible to infection with this organism via the nostril, and the disease occurs almost always during that period when the fly is active. On some farms

where inquiries have been made the farmer has noticed an unusual sort of fly worrying the sheep, and in other cases the sheep have been observed to show excitement and a tendency to rub the nose on the ground although no fly has actually been observed. A search has been made for first-stage larvæ of this fly in several affected heads without success, but recently Mr. A. L. Thompson, Veterinarian, Live-stock Division, discovered a number of them in the upper parts of the nasal cavities of an affected animal. Previous failures may easily have resulted from the very small size of the larvæ and the difficulty of detecting them in the rather complicated structures which occupy the cavity of the nose.

The possibilities which have to be considered so far as this theory is concerned are, firstly, that the fly may harbour the organism itself and deposit it with the larvæ in the sheep's nostrils. This is not very likely, because if it were so one would expect the incidence of the disease to be much greater than it is. Secondly, the fly may act as a mechanical carrier of the organism from an affected sheep to a healthy one. If this were so one would still be faced with the difficulty of finding out how the first sheep became affected. Moreover, the organism has so far not been detected in the nasal discharge which is seen in affected animals. Thirdly, the organism may be present in the nasal passages of many sheep, leading a harmless existence there as do many other species of microbe, but the irritation and slight damage to the lining membrane of the passage caused by the crawling over it of these larvæ in their wanderings may provide the organism with its opportunity to penetrate the surface and eventually take up its quarters in the brain, for which it evidently has a predilection.

CO-OPERATION OF FARMERS SOUGHT.

It is perhaps unusual to speculate to this extent on unproven theories, but it has been indulged in in this instance because the matter is a most difficult one to investigate owing to scarcity of material. There is reason to suppose that many farmers experience losses from this condition, but attribute them to "grub in the head" and let it go at that. One of the principal objects of this article, therefore, is to interest farmers in the condition, so that through their co-operation a wider knowledge of the disease may be obtained and a larger amount of data and specimens be available for further work. If any farmer who has losses of this nature, and is willing to give particulars about them, will communicate with the writer it will be greatly appreciated.

ACKNOWLEDGMENTS.

The writer has to acknowledge, very gratefully, the large amount of help which he has received, particularly from the field observations of Mr. A. L. Thompson, M.R.C.V.S., while stationed at Wanganui, and also from Mr. T. Hankin, B.V.Sc., M.R.C.V.S., Masterton, Mr. D. Marshall, M.R.C.V.S., Hamilton, Mr. E. Elphick, M.R.C.V.S., D.V.H., Hastings, and Mr. W. Bonner, Inspector of Stock, Te Kuiti. Mr. W. C. Barry, M.R.C.V.S., District Superintendent, Wellington, has also taken a keen interest in the work and furthered it whenever possible.

APPLE ROOT-STOCK INVESTIGATIONS.

WORK IN NEW ZEALAND BY THE PLANT RESEARCH STATION.

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WRITING in 1917 concerning the work on apple stocks at the Wye College Fruit Experimental Station, East Malling, Kent, Hatton said, "Most fruitgrowers are convinced that, as regards the tree itself, its period of maturity, its actual vigour, and even its constitution are largely affected by the stock on which it is worked. As regards the fruit, it appears equally probable that its quality, embracing degrees of colour, size, and flavour, may be likewise influenced. Yet there exists very little, if any, reliable data upon these facts which open up a whole vista of possibilities for progress of economic importance."

Since then there have been sorted out and multiplied at East Malling some sixteen types of stock suitable for various purposes and conditions. Some of these have been received and grown at the New Zealand Plant Research Station, and arrangements are in hand to test their possibilities for our conditions. Other experimental lots have also been introduced into the Dominion.

The work at East Malling and elsewhere has shown that the stock influences considerably the behaviour of the tree, particularly as to vigour, habit of growth, period of maturing, and cropping qualities. It is obvious, therefore, that standardization of stocks is an important factor in securing greater uniformity of growth and crop output per tree.

In connection with its fruit research work, the Plant Research Station was asked to investigate the possibilities of improving and classifying stocks, especially for apples, already in use in this country. As the aphid-resistant Northern Spy is the major stock in use, it has received special attention, and this article aims to present, without going into great detail, the stage so far reached in our studies. In addition to small preliminary collections, stocks were obtained by root cuttings from numerous orchards in all the apple-growing areas. When obtaining these cuttings the Orchard Instructors were asked to select material from trees of (1) outstanding, (2) normal, and (3) subnormal growth. Unfortunately, the period after the receipt of the cuttings was an exceptionally dry one, and only a proportion of the stocks grew. Arrangements have been made to fill the blanks in the present season.

The great majority of the stocks proved to conform to a single type, as far as vegetative characters reveal type—our Type I. In the preliminary nursery collection eight other district types were isolated, represented by a few specimens, and in some cases by a single specimen. One of these types turned up in the main collection, as well as certain seedling stocks of unknown origin. It is not yet established whether all of the nine types under study are rightly to be classed as Northern Spy. As Type I preponderated in the collection made by Orchard Instructors, it was possible to study it in relation to the three classes of trees. No correlation could

be found, and it would appear that the relative vigour of the trees was due to factors other than stock type.

The types isolated (see illustration) may be briefly characterized as follows :—

Type I: Growth strong and vigorous; leaves larger than in any other type, except Type V, standing away horizontally from the stem, and curving downwards at the apex.

Type II: Growth short but sturdy, with a tendency to branch at the base; leaves medium, somewhat concave, very wavy, of rather erect pose.

Type III: Growth short and slender; leaves very small, narrow, flat, rather smooth, of nearly horizontal pose. The general appearance suggests lack of vigour.

Type IV: Growth short and sturdy; leaves medium to small, very broad, flat to slightly concave, unwaved, of very erect pose.

Type V: Growth exceptionally strong and vigorous; leaves large, broad, very concave, dark green and glossy, apex with a prolonged point, of horizontal to slightly drooping pose. The shoots are straight and free from branches, making them about ideal for working. A promising type, but possibly not a Northern Spy, although it appears to be aphid-resistant.

Type VI: Growth rather weak and slender; leaves long, narrow, somewhat concave, upper surface glossy, lower very hairy, of horizontal pose.

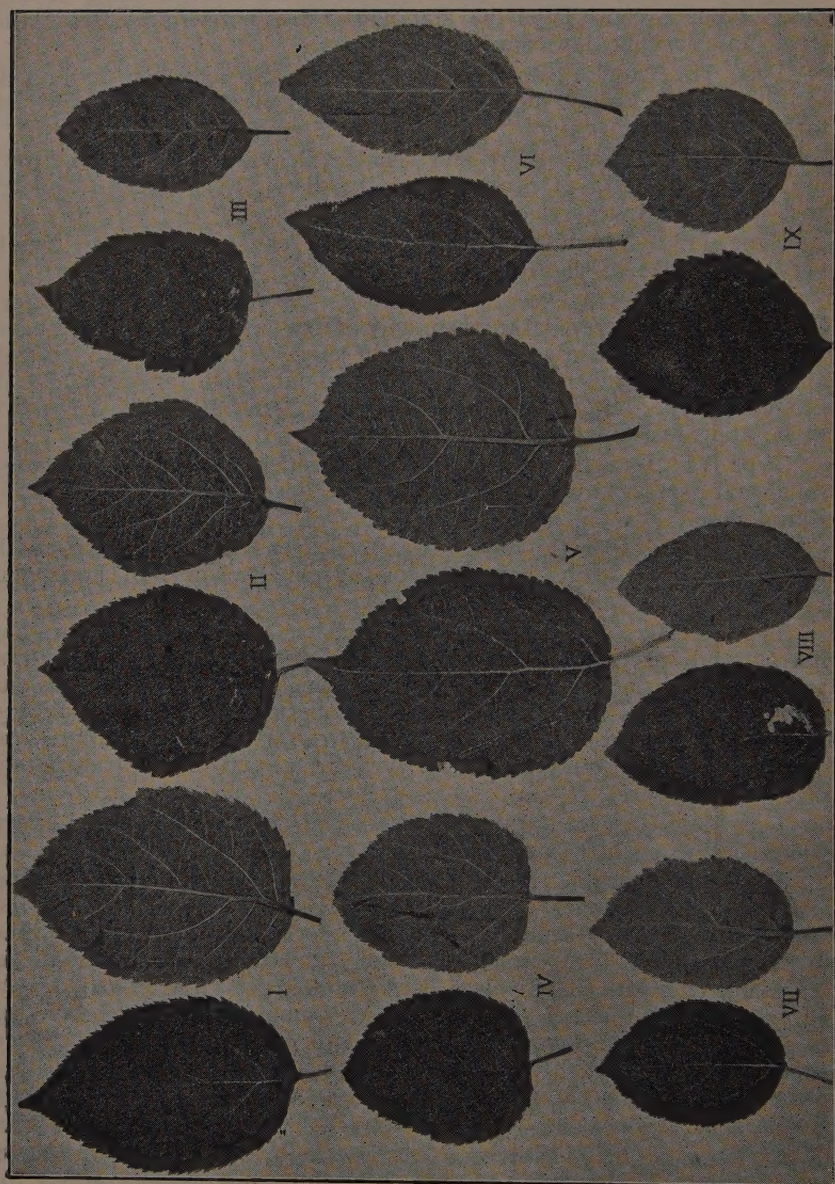
Type VII: Growth rather weak; leaves small, concave, with rounded regular teeth, lower surface extremely hairy, of horizontal pose.

Type VIII: Growth short and sturdy; leaves medium, rather narrow and wavy, surface flat to slightly concave, with blunt shallow teeth, undersurface very hairy, of drooping pose. The leaf colour of this type is a bright green. The formation of fruit-buds on the annual shoots, and the stout but stunted growth, give the impression that this stock would induce early bearing and have a definitely dwarfing influence.

Type IX: Growth sturdy; leaves small, rather broad, and very wavy, flat to slightly convex, dull.

These nine types have been worked on the East Malling Dwarfing Stock No. IX. As this is a very precocious stock, the fruit of these types should be available for comparison within three or four years. Five types, referred to later, received from an Auckland grower, have also been worked on the same stock. Propagation of the types has also been commenced by the layering method. Of these, layers in quantity will not be available for some time, except of Type I. In view of considerations mentioned later on the stock work has been extended to a study of various seedling stocks, and of stocks from certain trees showing exceptional features.

An examination of Northern Spy trees grown in certain Auckland orchards, where the Northern Spy is still to some extent grown for its fruit, showed that these were all of Type I as far as vegetative growth is concerned. We were informed, however, that various classes of fruit were produced, differing in colour, texture, and shape. Bud wood representing the more distinct of these classes has been



PAIRED LEAVES OF THE NINE TYPES OF NORTHERN SPY STOCK UNDER STUDY AT THE PLANT RESEARCH STATION.

received, and has been worked for further observations. It is quite possible that important physiological differences may occur within a morphologically uniform type.

In preparation for stock trials in the various fruitgrowing districts some hundreds of the East Malling apple (as well as stone fruit) stocks have been budded with a range of varieties. A similar number of Northern Spy have been worked to afford a comparison.

In a Riwaka (Nelson) orchard it was noted that certain Sturmers on a non-aphis-proof (probably seedling) stock were superior in general vigour and cropping capacity to those on Spy stock. The growth of new wood in the Sturmer on Spy stock decreases rapidly when fruit-bearing commences, and eventually comes almost to a standstill in spite of severe pruning. This stock would appear to be worth testing as a stock for the Sturmer variety in orchards in this and similar districts. A parallel case was noted in an Ettrick (Otago) orchard. It was noted also that in certain orchards Delicious worked on Northern Spy had a very insecure root-hold. It would appear that under certain conditions the Northern Spy should be replaced in these varieties by other stocks. At Mapua some Jonathan trees on a seedling stock were much larger and carried heavier crops than those on Northern Spy under similar soil conditions. Root cuttings have been obtained from the stocks above mentioned.

The evidence of the trial blocks at the Cawthron Institute orchard also suggests that trees on the Double Vigour and on certain seedling stocks may have, under the conditions of that orchard, more vigorous growth and come into bearing later than those on Northern Spy. It may be that on the comparatively poor lands in parts of the Nelson apple-growing areas a more vigorous stock than Northern Spy is required for varieties of weaker habit, such as Cox's Orange and Jonathan. This view is supported by the fact that when odd trees on seedling stock are met with on the same class of soil they show superior growth. Further, seedlings are usually deep-rooting and well furnished with fibrous roots, whereas the Northern Spy has a shallow and comparatively coarse root-system.

It is not to be inferred that we are recommending the use of mixed collections of seedling stocks. The different types of these need isolation and standardization with a view to testing their capabilities. It is also to be said that among the Northern Spy types we may possess such as have the required vigour combined with the other desirable Northern Spy qualities. But the general statement may be made that no single type of stock can be expected to produce the best results with all varieties. A point that is engaging our attention is the effect of double working on stock and scion; there are indications that this may at times be a valuable practice.

Even when tested types of stock are available, it will remain of great importance that very accurate grading of nursery material be made in order to secure close uniformity of growth. This is true even where clone stocks are used. This need for accurate grading has not, perhaps, always been recognized in nursery practice, and the lack of attention to it may account for a good deal of the diversity of growth on what is taken to be a single line of stock.

THE NAPIER-AHURIRI LAGOON LANDS.

(Continued from February Issue.)

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EFFECTS OF VARIOUS FORMS OF LIFE IN INCREASING SOIL FERTILITY.

IT will be seen on inspection of the analyses in this and the previous article that there is in the case of the Napier lagoon lands no exception to the New Zealand rule that such coastal soils are very rich in lime, phosphate, potash, magnesia, and other mineral plant-foods, and that when circumstances permit of the growth of the usual land plants, nitrogenous organic matter may be expected to accumulate in the new soils at a fairly rapid rate, and thus finally to promote a high degree of soil fertility.

It will be noticed from the analyses how small is the amount of the organic matter in the recently emerged lands, and in this respect what a difference there is between these and the soil which can grow dry-land plants only subject to periodical salt-water flooding (samples C/195-199 and C/384, February *Journal*). The most prominent evidence of past life are the beds of shells of marine animals, cockles, pipis, &c., which are present in most of the soils to some extent and in some are the predominating ingredient so that there appears to be more shells than soil particles. The extent to which the shell particles small enough to be included in the soil—that is, material which will pass a 2 mm. sieve (0.078 in.)—vary may be gauged by the percentage of carbon dioxide shown in the analyses, remembering that one part of carbon dioxide (CO_2) equals two and one-third parts of carbonate of lime (CaCO_3). It is thus seen that the shingle beach provides, on sieving off the stones and gravel, a sand which contains over 10 per cent. of carbonate of lime. There is here, therefore, on land elevated beyond the reach of the highest tides, an area well worthy of immediate trials with lucerne and other valuable plants which will flourish on land of high lime content and are not killed by a salty environment.

In addition to the calcified remains of life in the form of shells, one must not forget the organic part of the remains and the excreta from birds and other animals which leave behind in the soil phosphate of a high degree of availability which is the very element most deficient in New Zealand soils. In the Napier raised lands this ingredient is present in amounts from one and a half to three and a half times greater than are found in ordinary farm soils. The other valuable plant-food, potash, is present in extraordinary high amounts, that available as immediate plant-food being from four to ten times as great as is found in average farm soils, and the "total" amount being also very high.

Owing to the action of life and the solvent action of salt water on the mineral matters of the soil, there is thus round Napier a land surface of great potentiality as an intensive farming and market-gardening centre. That improvement of the area is still

going on cannot be doubted on seeing the hundreds of wild water-birds—black swans, paradise ducks (New Zealand sheldrake), stilts, and true duck, as well as seagulls, shags, and terns, while smaller numbers of the blue heron, bittern, dotterel, and pukeko are also present. Thousands of starlings are also making the mud flats a feeding-ground. Some of these species of wild fowl are largely vegetable feeders, and are acting as cattle do on pasture—that is, they convert large quantities of waterweed and other vegetable matter into quickly decomposable excreta of high value as a top-dressing; other species of birds are more intent on devouring small animals on the flats, and their labours would also result in increased fertility.

PLANTS THAT MAY INDICATE THE EXTENT OF SALINITY IN SOILS.

From a review of the figures given for chlorides calculated as common salt (sodium chloride) of the Napier soils it will be seen from the following results that there is room for hope that certain plants may be indicators of the amounts of chlorides present in any similar soil. When *Salicornia australis* (salt weed or Australian glasswort) is present in a close almost pure mat. of plants it apparently indicates between $1\frac{1}{2}$ and 2 per cent. of salt present, but this species may do quite well for a time on soil with as little as 1 per cent. when there is no competition. For instance, in sample C/374 (Field No. 28) where *Salicornia* was being smothered by the introduced legume *Melilotus* it was quite healthy, but the other faster-growing plant was able to suppress it, and on this soil there was only 0.49 per cent. of salt.

Again, on recently dried cracked land at Seafeld Bay (sample C/1292, Field No. 68) there was only 1 per cent. of salt present, and the *Salicornia* was scattered about as tall vigorously growing plants, evidently the first plant colonists to arrive, and there being no competition it had grown vigorously.

Other halophytes, the annual *Chenopodium glaucum* or native goosefoot, and *Atropis stricta*, a salt-loving native grass, are apparently able to endure an even greater amount of salt than is found where *Salicornia* grows alone, since they grow on land (samples C/1277, Field No. 51, and C/1278, Field No. 53) containing from 2.21 per cent. to 2.69 per cent. of salt. Apparently one may regard the existence of *Salicornia*, *Chenopodium*, and the grass *Atropis* in the presence of competition as indicating an injuriously high salt content, but on recently dried-out lands, where the only seed possible to be present is that which can come from the halophytes, they will cease to be an indication in this temporary phase before full colonization occurs. In practice, however, this need not cause any doubts, as the distribution of seed on to new ground by natural means is so rapid that taller plants are sure to occupy the ground quickly when ever the conditions are favourable and will smother out the low-growing halophytes.

The interesting observation is made in Dr. L. Cockayne's "Vegetation in New Zealand," 1928, p. 82, that "*Salicornia* will not grow in sticky mud. It especially favours sandy mud or well drained mud or shingle. It cannot tolerate stagnation." The



FIG. 1. VIEW FROM PETANE END OF LAGOON.

Showing patch of *Scirpus* (like raupo) in middle foreground, with *Juncus* next the water.

[Photo by R. E. R. Grimmett—March, 1933.]



FIG. 2. AREA OF CRACKED MUD, MACDONALD BLOCK, HALF A MILE INLAND FROM TARADALE ROAD.

Plants of *Chenopodium* and *Salicornia* may be seen establishing.

[Photo by C. R. Taylor—August, 1932.]

mechanical analyses of the Napier lagoon lands show that there are no soils which could be called sticky muds that are growing *Salicornia*. The large areas of this plant are therefore another indication that the mechanical state of the soils is one which would allow rapid drainage when channels are constructed so that surface-waters may readily escape.

Another lowly plant which occupies large moist areas round the lagoon from which the salt has been washed, leaving the soil only slightly brackish, is the composite plant *Cotula coronopifolia* (the swamp cotula or "yellow buttons"), a widely spread weed in the south temperate zone. This is a plant which forms pure associations and apparently is easily killed out by water submergence, but reproduces itself at a great rate, millions of seedlings springing from the abundant seed shed. According to the analyses of four soils, the salt content of soils on which the species predominates is low, being from 0.69 per cent. to 0.43 per cent., so that it is an indication of land which is reduced enough in salt content to drain and reclaim.

Scirpus maritimus, the tall leafy swamp plant that favours salty estuarial situations which are subject to periodical flooding, is known to the Maoris of the Northern estuaries as "purua grass," cattle browsing it readily when allowed. It, like the *Typha* (bullrush or raupo), dies back in the autumn, leaving a mass of dead brown leaves and stalks up to 6 ft. in height, and a fire may readily be then put through the dead mass. In the spring, growth rapidly begins again, starting from the small round woody tubers. This plant does not usually grow on the saltiest land, but seems to be unaffected by excess, and was found growing on land containing up to 1.5 per cent. of salt.

A mixed halophyte association on the MacDonald Block contained *Chenopodium glaucum* (native goosefoot), and this seems to be able to thrive on the most salty and poisonous soils, even those containing much magnesium sulphate. At the time of the writer's March, 1933, visit the barren portion of the MacDonald Block was rapidly being covered by seedlings of this plant, which may have a feeding-value, as the closely allied *C. album* (fat-hen) is known to be a favourite food for lambs.

Some grazing experiments with sheep on the MacDonald Block are certainly indicated as desirable to determine the palatability of

Table 1.—Relation of Soil Salinity to Plant Covering.

Laboratory No.	Field No.	Percentage of Sodium Chloride (NaCl).	Laboratory No.	Field No.	Percentage of Sodium Chloride (NaCl).
<i>Salicornia</i> Soils (<i>Salicornia</i> healthy and well-grown thick mat except in No. 68).			<i>Scirpus Maritimus</i> Soils (<i>Scirpus</i> of varying heights).		
C/384	38	1.91	C/878	42	0.72
C/880	44	1.68	C/1280	55	1.53
C/885	49	1.67	C/1286	62	0.43
C/1288	64	1.29	C/197	2	0.35
C/1292	68	1.01*	C/380	34	0.39
C/1294	70	1.60	C/199	3	0.95
<i>Cotula Coronopifolia</i> Soils.			<i>Mixed Halophyte</i> Soils (<i>Salicornia</i> , <i>Chenopodium</i> , <i>Atropis</i>).		
C/378	32	0.69	C/1276	51	2.69
C/886	50	0.49	C/1278	53	2.21
C/1290	66	0.70	C/1288	64	1.29

* Mostly bare cracked land with *Salicornia* as a first colonist liable to displacement.

Chenopodium glaucum and the closely allied *Atriplex* species and other plants growing on this salty soil. If found adaptable for sheep, seeds could be obtained from any plant there and sown in other bare areas where sheep are grazing at the north end of the lagoon.

Table 1 (preceding page) indicates the relation of soil salinity to plant covering on the various types referred to.

STRAWBERRY CLOVER AS A SALINE PLANT STAPLE.

Strawberry clover (*Trifolium fragiferum*) has made an appearance on the private land adjacent to Block 3 on the MacDonald Block, and is well established round an artesian bore which is throwing up a splendid flow of fresh palatable water to a height of 6 ft. on to the salty lands below.

Practical farmers consider the feeding-value of this small clover, with large round heads the colour of a crushed strawberry, and like that fruit in size and shape, as equal to that of white clover, some strains of which it much resembles in the creeping habit. The unusual character of the plant which makes it so valuable in coastal farming is that it will stand submerging with either fresh or brackish water for a prolonged period. The seed is dearer than the other clover seeds, and when bought is somewhat erratic in germinating-power, but here is a large patch where plants and fresh seed could be obtained in order to start the growth in other suitable places all round the lagoon, and thereby greatly enhance the grazing-value to neighbouring settlers.

On the west side of the lagoon, above Park Island, a 3-in. increase in the depth of the water which may possibly come with the winter rains would cover some 5 or 6 chains of ground at present bare and practically barren between the present water margin and the cliffs. There must thus be on the shores of this immense lagoon large areas where the conditions are suitable for the growth of this desirable food plant that will withstand any amount of bad treatment, such as inundating with salt or brackish water.

An instance has been quoted before in this *Journal* where at a Himitangi (Foxton) sandhills farm strawberry clover flourishes exceedingly and is readily grazed by the dairy herd. In the sand hollows there is sometimes as much as a foot of brackish water in the winter, the bottom being carpeted with this clover. The production in terms of butterfat from this farm, according to the owner, is equal to that of high-priced land at Turakina under the same proprietary.

Propagating strawberry clover by roots would seem to be a recognized practice in Australia, where it is a most esteemed fodder for cattle, horses, and pigs, since it was quoted in July, 1932, by an Australian firm at 25s. per sack of roots. Sheep tend to eat this clover out owing to close grazing, a tribute to its extreme palatableness. An Australian authority states that for dairying as well as for fattening cattle for market it is superior in feeding-value to rye-grass and lucerne.

TABLE 2.—CHEMICAL ANALYSES OF NAPIER-AHURIRI LAGOON SOILS.

Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Field No., Texture, Locality, Plant Association, &c.	Volatile Matter.			Total Nitrogen.			1-per-cent. Citric-acid Extract. Dyer's Method, Hall's Modification. ("Available Plant-food.")				Hydrochloric-acid Extract. ("Total Plant-food.")				Sodium Chloride NaCl.	Magnesium Sulphate MgSO ₄ .	CO ₂ .	Other Sulphates K ₂ SO ₄ , &c.	pH *
		*On Atr.-drying.	*At 100° C.	On Ignition.				Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .					
C/876	(40) Loam, MacDonald Block, No. 3; dead <i>Salicornia</i>	28.4	1.18	5.74	0.125	0.268	0.190	0.051	0.057	1.39	1.52	0.95	0.12	0.12	0.12	1.12	0.20	0.03	0.11	7.0
C/877	(41) Loam, MacDonald Block, No. 4; cracked, nearly barren	28.9	1.74	6.84	0.161	1.169	0.276	0.065	0.021	2.63	1.63	0.98	0.08	0.08	0.08	1.40	0.40	0.73	0.46	7.5
C/878	(42) Silt loam, MacDonald Block, No. 4; <i>Scirpus maritimus</i>	33.3	1.62	7.16	0.226	1.776	0.252	0.047	0.020	3.35	1.70	1.00	0.10	0.10	0.10	0.72	0.20	1.25	0.40	7.5
C/879	(43) Silt loam, MacDonald Block, No. 2; cracked, <i>Scirpus, Salicornia</i>	31.1	2.44	7.76	0.172	0.580	0.236	0.054	0.035	2.32	1.80	1.05	0.12	0.12	0.12	1.58	0.40	0.49	0.38	7.5
C/880	(44) Silt loam, MacDonald Block, No. 1; green <i>Salicornia</i> , being ploughed	22.3	2.22	6.46	0.132	0.728	0.280	0.077	0.031	1.58	1.68	1.00	0.12	0.12	0.12	1.68	0.20	0.08	0.09	7.4
C/881	(45) Clay loam; cracked area near Quarantine Island, barren	25.6	1.36	6.53	0.170	0.534	0.228	0.069	0.032	1.62	1.56	1.02	0.08	0.08	0.08	1.04	0.40	0.15	0.61	5.1
C/882	(46) Fine sandy loam; uncracked area near Quarantine Island	19.8	0.66	3.00	0.040	0.484	0.136	0.033	0.032	1.69	1.10	0.77	0.08	0.08	0.08	0.48	0.20	0.26	0.16	7.6
C/883	(47) Fine sand; edge of lagoon, Seafield Bay	18.6	0.32	2.80	0.025	0.885	0.155	0.043	0.014	2.19	1.02	0.68	0.05	0.05	0.05	0.64	0.20	0.59	0.13	7.9
C/884	(48) Loamy silt, north of Quarantine Island; <i>juncetum</i>	25.4	1.20	5.88	0.136	0.206	0.222	0.055	0.041	1.33	1.48	0.93	0.07	0.07	0.07	1.65	0.29	0.03	0.06	7.0
C/885	(49) Fine sandy loam, Park Island; <i>Salicornia</i> , pure association	20.4	0.88	4.66	0.056	0.614	0.246	0.062	0.026	1.84	1.40	0.84	0.10	0.10	0.10	1.67	0.15	0.41	0.08	8.0
C/886	(50) Fine sandy loam, Park Island; <i>Cotula coronopifolia</i> association	19.1	0.36	2.90	0.034	0.711	0.160	0.044	0.024	1.96	1.12	0.76	0.07	0.07	0.07	0.49	0.15	0.44	0.13	7.8
C/1284	(60) Loamy silt, 40-acre paddock near Racecourse, pure <i>Salicornia</i>	23.1	1.6	5.3	0.085	..	..	..	..	1.80	1.60	0.95	0.10	0.10	0.10	2.42	..	0.40	..	8.0
C/1286	(62) Fine sandy loam, old river channel; <i>Scirpus maritimus</i>	21.1	0.8	3.1	0.054	..	..	..	..	2.27	1.22	0.87	0.08	0.08	0.08	0.43	..	0.82	..	7.9
C/1288	(64) Fine sandy silt, old river channel; <i>Salicornia</i> , &c.	22.6	1.1	3.6	0.059	..	..	..	..	2.13	1.28	0.93	0.09	0.09	0.09	1.29	..	0.72	..	7.9
C/1290	(66) Loam, Seafield Bay Head; <i>Cotula</i> flat	35.6	1.5	6.9	0.185	..	..	..	..	2.05	1.28	0.98	0.08	0.08	0.08	0.70	..	0.55	..	7.6
C/1292	(68) Silt loam, Seafield Bay; cracked land, mostly bare	20.0	3.1	7.7	0.205	..	..	..	..	2.08	1.52	1.01	0.10	0.10	0.10	1.01	..	0.57	..	7.6
C/1294	(70) Fine sandy loam, Seafield Bay; Lopdell's <i>Salicornia</i> paddock	34.5	2.5	8.5	0.297	..	..	..	..	1.85	1.28	0.79	0.07	0.07	0.07	1.60	..	0.50	..	6.6

[Analyses by F. J. A. Brogan and E. B. Davies.

NOTE.—The analyses of the citric extracts of the soils containing much carbonate are approximate only, owing to the impossibility of making exact corrections for the effect of the carbonate.

The question whether it will succeed under the Napier conditions is already answered by the vigorous growth round the bore mentioned, which being on the flat must be subject to some rigorous frosts in winter. It is not intended to advocate this species against white clover, but to emphasize the fact that it will occupy situations where white clover cannot possibly exist owing to salt, swampy conditions. Many useful plants which occur on other similar soils may be expected to appear from time to time in this area owing to the migration of water-birds from one feeding-ground to another.

SOME LATER DEVELOPMENTS ON THE RAISED LANDS.

The most striking alteration in the appearance of the raised lands since the writer's visit in July, 1932, is the diminution in the extent of the lagoon waters, which by drying up or by percolation have considerably shrunk in area, leaving a large area of flats bare of plant-life and ready to be colonized by the first seeds which arrive and which can germinate and survive under the conditions existing. The seed will probably be brought by birds or by wind. The winter rains may, however, result in an extension of the lagoon waters, and thus prevent any but specialized plants from surviving.

The MacDonald Block has been leased to three farmers, who are taking steps to convert it into permanent pasture. A new feature of this area is the rapid spread of the native annual *Chenopodium glaucum*, the seedlings of which have taken possession of some of the most salty portions of the block.

In the wild life of the flats a most astonishing and notable change was the entire absence of the black swan, not a single bird being seen during either the January or March visit, although so abundant in July. On the other hand, much larger numbers of other birds were seen, including large flocks of paradise duck, while at the same time other New Zealand water-birds—stilts, banded dotterel, and bittern, &c.—had increased. Large flocks of starlings were probably feeding on a species of crab which is on the increase.

FURTHER SOIL ANALYSES.

The accompanying tabular statement shows the results of chemical analysis, with an indication of the textural type to which each sample belongs, from those collected during the January (Field Nos. 40-50) and March (Nos. 60-70) visits. The figures for available mineral plant-food continue to be high, including those of the more valuable potash and phosphoric acid. The total mineral plant-food present is also very high, with the exception of phosphoric acid, which is normal. The mechanical composition of the soil continues to be satisfactory, only one sample (C/881)—a clay loam from an acid, barren, cracked area near Quarantine Island—being at all suspicious from its heavy nature and high amount of magnesium sulphate. The high amount of lime present in practically all the soils continues to be a satisfactory feature.

NOTES.—The scale of the map of the lagoon on page 70 of the February Journal is 100 chains to 1 inch, as stated on page 123 of the same issue.

In the previous article (page 71) the distance from Napier to Tangoio was stated to be thirty miles. This should have read about thirteen miles.

(To be continued.)

THE POINT METHOD OF PASTURE ANALYSIS.

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IN the making of pastures there are two major practical considerations—(1) the amount and quality of herbage produced, and (2) the species that contribute to that production. The formulation of seed mixtures in the past has been based more on what the seed-merchant has to sell than on an exact knowledge of just which species will contribute to the make-up of the pasture sward. Thousands of pounds' worth of seed have been wasted, and are still being wasted, in the laying-down of pastures because of the dearth of knowledge of the actual performance of the various seeds sown. Careful observations of the actual components of the sward have led to a great improvement in the efficacy and economy of such mixtures, but there is still much to learn in regard to species, including strains of these, in relation to total and seasonal production from pasture.

In grassland ecology the classification of vegetation types is of paramount importance. Fundamental to all research work on pastures—whether botanical, ecological, chemical, physical, or biological—the basis is that the work should be performed on known association types. The multiplicity of factors operating in grassland has its reflex in the growth produced on the soil surface, and sustained growth over a definite period will stamp itself on the botanical composition of the sward. Thus the factors of soil fertility, soil moisture, soil aeration, the soil flora and fauna, light and shade, temperature, wind, and the complex biotic factor generally are reflected in the turf produced, and because of this it would appear imperative in any grassland inquiry to work entirely on known association types.

The point method of pasture analysis makes the recognition of pasture association types possible, and it is the purpose of this article to explain the point method and its application.

This method is based on the mathematical concept of the homogeneity of a unit area as represented by a pin-point. Provided a sufficient number of pin-points are taken, an elaborate picture may be reproduced. The photo-engraver's half-tone reproduction is a case in point. In charting vegetation, provided a sufficient number of pin-points of vegetation are examined, an accurate representation of that vegetation will be secured. The method had its origin in a suggestion made to the senior writer by Dr. L. Cockayne, F.R.S., to the effect that a pin-point would prove mathematically sound as the basis of a method for charting vegetation. In his researches into the regressing of depleted tussock grassland in Central Otago, Dr. Cockayne and his assistant, Mr. W. D. Reid, used a point on the toe-cap of one boot as the mathematical point.* At the same time a knotted string tightly stretched over

* Aims and Methods in the Study of Vegetation. Ed. A. G. Tansley and T. F. Chipp, London, 1926. Tussock Grassland Investigation in New Zealand, by Leonard Cockayne, p. 352.

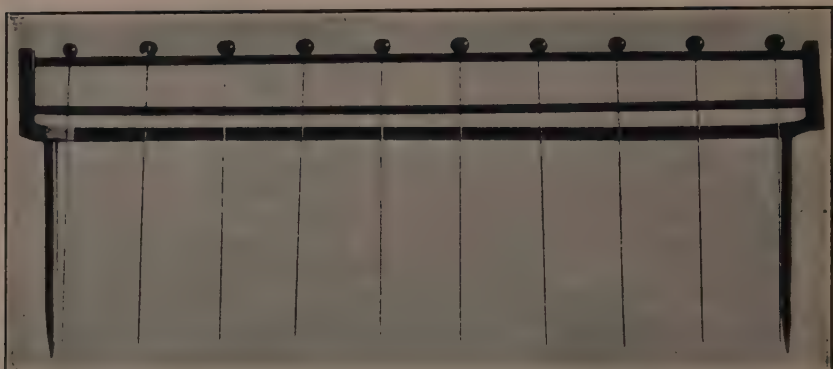


FIG. 1. THE POINT ANALYSER AS NOW USED IN NEW ZEALAND.

The frame is made of $\frac{1}{2}$ in. brass casting, and is 20 in. in length. The legs are pointed and screw into the upper frame, which enables packing of the apparatus in a comparatively small compass.

[Photo by E. A. Madden.]



FIG. 2. CLOSE-UP VIEW OF THE POINT ANALYSER UNDER USE IN DETERMINING THE CONSTITUTION AND DENSITY OF A LAWN TURF.

The pins slide up and down, and the direction is maintained by virtue of the bars carrying the pins being spaced apart.

[Photo by E. Bruce Levy.]

a grass sward was employed for charting the vegetation of a sown pasture.

From these beginnings has arisen the present point method evolved by the writers. The method consists in taking a number of points at random and in recording all vegetation that is hit as the point is projected from above into the sward. The apparatus used

is a frame, mounted on legs pointed to facilitate pushing into the soil, and carrying a row of steel pins (hat-pins serve excellently) 2 in. apart so held that they slide up and down in a set course. The number of pins is simply to facilitate charting, and to avoid removing the pin from the slot each time a new point is being examined. The apparatus used at this Station really does a line transect of 10 points 2 in. apart. The number of needles, however, is quite immaterial, provided a sufficient number of points are taken. For charting a pasture sward where the dominants only are required 100 points are sufficient, but where it is necessary to record the lesser constituents also 400 to 500 points are required.

In recording "hits" as the needle descends all species so hit are recorded in any one downward projection. Thus the needle-point may strike a rye-grass leaf in the upper story, a cocksfoot leaf a little lower down, and in the bottom story a white clover leaf. These three species are all recorded as covering the unit point of ground covered by the descending needle. Thus for every 100 points examined more than 100 points of vegetation may be charted, according to the number of stories and species of vegetation present in the sward. It will be noted that the method as defined above is a species ground-cover method. By recording every leaf hit, irrespective of whether the same or another species, the relative percentage of each species in the sward may be ascertained, but these analyses take much longer to make.

In setting out the results of the analyses there are really four issues involved: (1) The percentage of ground covered by each species; (2) the percentage cover each species is contributing to the total area (1st + 2nd + x stories + bare ground); (3) the relative frequency of each species in the pasture sward; (4) the percentage that each species is contributing to the pasture sward. The following short exposition may make these applications clearer.

(1) *Percentage of Ground covered by each Species*.—This datum is secured by recording in each downward projection all species hit and in expressing these in terms of percentage for every 100 points examined. It will be realized that in a dense pasture with several dominants occupying different stories the sum of the percentages of ground covered by each species plus the percentage of bare ground in any one analysis will exceed 100, for the reason that one or more species are covering the same unit of ground. This is exemplified in Analysis A, Series 1, in Table 1. Here 51% of the ground is covered by rye-grass, 15% by cocksfoot, 19% by white clover, 8% by *Poa pratensis*, 18% by weeds, and 19% of the ground is bare of vegetation, a total of 130 recordings per 100 points examined.

(2) *Percentage Cover each Species is contributing to the Total Area (1st + 2nd + x Stories + Bare Ground)*.—This is secured from the ordinary 100-point analysis in (1) above by application of the following formula:—

Number of times a species is hit per 100 points examined $\times$ (100 — percentage of bare ground).

Total times vegetation is hit per 100 points examined.

Thus in Analysis B, Series 1, in Table 1, of the total area examined perennial rye-grass is contributing to that total 37.2%, cocksfoot 11%, white clover 13.9%, *Poa pratensis* 5.8%, weeds 13.2%, bare ground 19% = total 100%.

(3) *Relative Frequency of each Species in the Cover.*—This is secured by examining the vegetation story by story, and in recording every hit as the needle descends, irrespective of whether the same or a different species is hit. Thus in Analysis C, Series 1, in Table 1, rye-grass in all stories has been hit 72 times, cocksfoot 21 times, white clover 19 times, *Poa pratensis* 10 times, and weeds 19 times per 100 points examined.

(4) *Percentage each Species is contributing to the Pasture Sward.*—This is secured by computing percentage composition of the sward based on the number of hits of each species in relation to the total number of hits of vegetation according to the following simple formula :—

$$\frac{\text{Number of times a species is hit}}{\text{Total times vegetation is hit}} \times 100.$$

Thus in Analysis D, Series 1, in Table 1, 51% of the vegetation is rye-grass, 14.9% is cocksfoot, 13.5% is white clover, 7.1% is *Poa pratensis*, and 13.5% is weeds = total 100%.

Table 1.—Showing Style of Analysis and Application of the Point Method.

Analyses.	Series.	Component Species.					
		Rye-grass.	Cocksfoot.	White Clover.	<i>Poa pratensis</i> .	Weeds.	Bare Ground.
A. Ordinary point analysis "hits" per 100 points examined = percentage of ground covered by each species	1	51	15	19	8	18	19
	2	52	25	23	15	18	11
	3	52	13	19	9	29	16
	Average	51.6	17.6	20.3	10.6	21.6	15.3
B. Ordinary point analysis reduced to percentage cover basis = percentage of cover each species is contributing to total area	1	37.2	11.0	13.9	5.8	13.2	19
	2	34.8	16.7	15.4	10.0	12.0	11
	3	35.8	9.0	13.1	6.2	19.9	16
	Average	35.9	12.2	14.1	7.4	15.0	15.3
C. Point analysis in stories "hits" per 100 points examined = relative frequency of each species	1	72	21	19	10	19	19
	2	75	26	24	18	18	11
	3	79	16	20	10	30	16
	Average	75.3	21	21	12.6	22.3	15.3
D. Point analysis in stories reduced to percentage basis = percentage of each species in the sward	1	51.0	14.9	13.5	7.1	13.5	19
	2	46.6	16.1	14.9	11.2	11.2	11
	3	51.0	10.3	12.9	6.5	19.3	16
	Average	49.6	13.8	13.7	8.3	14.6	15.3
E. Percentage of actual dry weight of component species on separation	..	50.8	13.9	12.9	9.2	13.2	..
F. Point analysis of -plucked herbage spread out on table	1	34	19	21	12	14	..
	2	59	13	8	9	11	..
	3	40	18	14	10	18	..
	Average	44.3	16.6	14.3	10.3	14.3	..

This latter analysis should agree fairly well with actual weight analyses of the component species on separation, assuming that bulk for bulk a unit section of rye-grass leaf weighs the same as a unit section of cocksfoot, white clover, &c. This analysis should also agree fairly closely with the table analysis (F) of the plucked herbage, provided all vegetation is plucked when collecting the sample. This proviso also applies in the case of the cut herbage from which the dry weight determinations of the component species were made. The analyses of a mixed pasture sward by the point method done in the ordinary way and in storys indicate the style of analyses possible by this method (Table 1). Samples of herbage were plucked for separation and percentage determination, and a point analysis of this plucked herbage spread out evenly on a table was also made.

In the study of succession or change brought about by any one factor it would appear that percentage of ground covered rather than percentage of composition of the sward represents the true position relative to gain or loss by each species. This may be inferred by a study of the analyses in Table 7.

Prior to adopting the method in field practice, trials were made in 1925 in estimating area occupied by coloured cards spread out in two storys deep on a table. Cards of five colours were used, each card 15 square inches. The size of these cards was unduly large, particularly in the case of the less dominant colours, making probably too few replications to give a thoroughly reliable estimate of cover as far as the lesser constituents are concerned.

By Measurement and Calculation—

Area of table		= 2,006 sq. in.
Area of table actually covered by cards		= 1,095 sq. in.
Area of table not covered = bare ground		= 911 sq. in.
Area of table covered twice by overlapping cards = 2nd story cover		= 150 sq. in.
Percentage of table not covered = bare ground		= 45.4
Percentage of table covered		= 54.6
Percentage of table covered twice by overlapping cards		= 7.5

By Determination by Point Analysis—

Ten analyses of 100 points each = 1,000 points examined were made, and the colours in each analysis were then totalled and averaged for the whole series with the results shown in Table 2.

It will be noted that the total percentage of table covered in Analyses A is greater than actual, taking the sum of the colours plus the bare ground, for the reason that two colours at the one time when placed in storys cover the same pin-point of surface. The figures in Analyses B = 100%, and these are derived by applying the formula given under (2) in the analyses in Table 1.

In 1925-26, when testing out the method in the field, ten analyses were made of the same line transect, each analysis consisting of 100 points 2 in. apart. This line transect was definitely pegged, and was analysed subsequently at different times throughout the year. (See Table 4 and Fig. 3.)

Table 3.—Showing Ten Separate 100-point Analyses of the same Line Transect, indicating the Relative Number of Points required to give an Accurate Analysis of the Sward. (Analysed 18th November, 1926. Grass, medium height. Paddock spelled. Species arranged in descending order of dominance.)

Table 3 shows the individual analyses of the same line transect all done in the one day, and gives a very good indication of the variations likely to arise in any one set of analyses. It will be seen that as far as the dominants are concerned any one set of 100 points gives a very reliable account of the vegetation of the sward. In the case of the lesser constituents a greater number of points than 100 are necessary; but it would appear that if we take at random any five analyses the average would closely represent the figure for the lesser constituents. In the case of those species occurring only as a trace in the sward, probably considerably more than five analyses of 100 points each are required, but the ultimate result would certainly not warrant the enormous amount of work involved.

Seasonal changes in rise and fall of pasture species may be accurately followed by the point method. This was attempted early after the adoption of the method, and the result of eight analyses of the same line transect during the year 1926-27, set out in Table 4, serve to show how such changes may be illustrated. The pasture chosen was a relatively stable run-out bush-burn sowing, and was particularly chosen because of the richness of the flora. From an agronomic point of view, perhaps the most outstanding result shown in these analyses is the rise to dominance of white clover during the summer period, and the failure of the annual suckling clover during that period. The maximum growth of pennyroyal in the summer is also indicated.

Table 4.—Showing Point Analyses of the same Line Transect at Eight Periods during 1926-27: 1,000 Points examined at each Analysis.

Species.	Percentage of Ground covered.							
	May.	June.	Aug.	Sept.	Oct.	Nov.	Dec.	Feb.
Bare ground ..	12.7	21.7	27.1	13.9	15.9	3.0	9.0	15.9
Perennial rye-grass ..	2.5	1.0	2.7	3.6	2.8	5.5	3.3	1.9
Cocksfoot ..	4.5	3.4	4.3	4.8	4.4	7.6	5.1	5.8
Yorkshire fog ..	7.1	5.4	3.8	5.7	6.7	10.7	7.2	5.2
Brown-top ..	6.5	7.4	9.2	8.9	8.7	10.0	7.2	4.3
Sweet vernal..	2.5	1.9	0.5	3.7	3.3	8.7	7.1	2.5
White clover..	15.5	10.1	5.0	8.1	10.0	13.0	11.5	28.1
Suckling clover ..	20.3	19.8	23.7	23.5	14.7	25.4	21.4	1.2
Poa pratensis ..	4.4	7.0	4.9	9.8	10.3	14.1	7.9	7.3
Danthonia pilosa ..	0.6	0.8	..	0.2	..	0.2	0.2	0.1
Hair-grass ..	1.4	1.0	0.4	1.0	3.5	7.5	5.0	1.6
Poa annua ..	0.4	0.6	1.8	4.5	10.4	8.4	4.3	..
Catsear ..	14.2	8.8	5.9	7.5	6.3	8.3	7.1	4.9
Pennyroyal ..	9.2	12.3	10.0	8.0	7.7	8.4	6.0	14.6
Rib-grass ..	4.1	2.5	1.0	1.9	2.3	5.4	2.9	3.9
Greater plantain ..	0.6	..	..	0.3	0.1	4.6	2.8	5.3
Selfheal ..	2.6	1.1	0.6	0.5	0.3	2.4	1.5	3.0
Creeping buttercup ..	5.7	2.2	1.1	0.9	1.8	1.1	1.0	0.3
Sorrel ..	3.1	2.1	1.0	2.2	0.7	2.8	1.1	3.5
Pearlwort ..	3.6	3.8	3.6	7.1	8.2	5.9	3.1	2.3
Oxalis corniculatus ..	0.4	0.3	0.2	0.3	0.9	1.3	1.3	1.6
Cudweed ..	9.4	3.7	2.0	3.7	2.9	7.7	6.6	8.6



FIG. 3. ANALYSING A HILL-COUNTRY PASTURE IN THE COURSE OF TESTING THE METHOD (SEE TABLE 3).

The line transect between the two pegs was analysed ten times in the one day, each analysis consisting of 100 points 2 in. apart. The pegs were permanently placed, and this enabled the same strip of ground to be analysed throughout the year (see Table 4).

[Photo by E. Bruce Levy.]



FIG. 4. OPERATING POINT ANALYSER IN CONNECTION WITH GREEN-KEEPING RESEARCH IN NEW ZEALAND.

A rubber kneeling-pad is a useful auxiliary of the equipment.

[Photo by E. Bruce Levy.]

The economy of seed mixtures may be definitely followed up by the use of the point analyser. The seed mixtures and analyses of the subsequent turfs set out in Tables 5 and 6 serve to illustrate this point.

Table 5.—*Showing Secondary Burn Sowing analysed, after Three Years down, to show which Species are the most economical to use in Seed Mixtures for this Class of Country.*

Species sown.	Pounds per Acre.	Cost per Pound.	Percentage of Cover after Three Years.	Relative Cost of Cover.
		s. d.		
Brown-top ..	2	1 6	39	100
Crested dogstail ..	4	1 0	11	473
Cocksfoot ..	8	1 3	2	6,500
Perennial rye-grass ..	6	0 6	3	1,300
White clover ..	2	1 6	3	1,300
Lotus major ..	1	2 6	21	154
Danthonia pilosa ..	3	1 3	11	441
Subterranean clover ..	$\frac{1}{2}$	2 0	2	650
Poa pratensis ..	1	2 0	2	1,300
Chewings fescue ..	1	1 0	1	1,300

Obviously the most economical species for the above class of country are brown-top, Lotus major, crested dogstail, and Danthonia pilosa. Rye-grass and white clover appeared useful in the earlier years and where the ground may be rendered more fertile by top-dressing.

Table 6.—*Showing Analysis of a First-class Dairying Pasture, after Four Years down, to show which Species are the most economical to use in Seed Mixtures for this Class of Country.*

Species sown.	Pounds per Acre.	Cost per Pound.	Percentage of Cover after Four Years.	Relative Cost of Cover.
		s. d.		
Perennial rye-grass ..	25	0 6	64.5	100
White clover ..	2	1 6	21.5	72
Cocksfoot ..	10	1 3	19.5	331
Crested dogstail ..	3	1 0	7.25	213
Timothy ..	3	0 9	2.75	422
Yorkshire fog*	..	..	16.25	..

* Volunteer component; undesirable competitor.

From this it will be seen that rye-grass and white clover are the most economical species in the mixture, and Timothy the least economical, assuming that all species are equivalent in food value.

The above analyses do not intend to demonstrate that the economy of pasture mixtures can be gauged by single analysis at a specific time after laying down, but they do serve to show that the point method can be used as a basis of an inquiry into the economics of seed mixtures sown. However, these analyses must be taken in relation to soil-type, to strains of species sown, season of the year, subsequent manuring, management, &c.

Change in pasture composition as a result of differential manuring, management, &c., may be accurately followed and recorded by the point method. This is exemplified in Table 7.

Table 7.—Showing Record by the Point Method of Changes in Composition due to Manuring with Superphosphate.

Species.	Example 1: Weak Worn-out Pasture. Percentage of Ground covered		Example 2: First-class Rye-grass and White Clover Dominant Pasture. Percentage of Ground covered			
	Before Top-dressing.	Twelve Months after.	Before Top-dressing.	2/12/30.	10/9/31.	23/8/32.
Bare ground ..	17	7	21	17	8	5
Perennial rye-grass ..	5	4	55	55	78	84
White clover ..	2	23	26	46	28	50
Suckling clover ..	3	19	..	..	..	..
Cocksfoot ..	10	8	..	..	..	..
Sweet vernal ..	19	21	4	1	2	6
Yorkshire fog ..	9	10	..	..	2	..
Poa pratensis ..	6	5	2	3	..	..
Brown-top ..	..	..	2	..	..	3
Red clover ..	..	..	2	..	..	..
Weeds ..	42	34	2	..	2	..

The effect of management and herbage utilization, in so far as these bring about changes in the composition of the sward, may be followed up by the point method. The analyses of the first-class rye-grass and white clover pasture, given in example 2, Table 7, were made on the pasture being subjected to the alternate mowing and grazing trial conducted at Marton by Hudson.* In a trial immediately alongside on the pasture referred to, where the sward was under continuous mowing for two years with a lawn-mower and similarly treated with phosphate, the point analysis shows a decided change in composition, as set out in Table 8.

Table 8.—Showing Record by Point Analyses of Change in Pasture Composition due to continuously cutting of Herbage with a Lawn-mower. (Compare with Example 2, Table 7.)

Species.	Percentage of Ground covered by each species.		
	Before Continuous Mowing commenced.	One Year later, 23/11/31.	Two Years later, 23/8/32.
Bare ground.. ..	21	3	1
Perennial rye-grass	50	32	37
White clover	30	92	81
Poa pratensis	6	15	11
Brown-top	3	2	3
Timothy	2	9	2
Sweet vernal	1	..	6
Yorkshire fog	..	1	2
Weeds (flat weeds mainly) ..	4	20	14

* Investigations into Pasture Production, Part I and Part III, Bulletin No. 31, New Zealand Department of Scientific and Industrial Research, by A. W. Hudson, Crop Experimentalist, Plant Research Station, Palmerston North, New Zealand.

The soundness or otherwise of an experimental technique, and the results secured on applying it, must clearly depend on whether the technique itself is a factor in altering the composition of the pasture from a species point of view.

The effects of close and continuous grazing, rotational grazing, ensiling, haying, topping, &c., on the botanical composition of the pasture could similarly be shown by the point method.

The point method, as a result of personal touch with New Zealand workers, is being adopted in other countries and recommended as a method for charting vegetation. G. Einar du Rietz, Upsala, in his paper "Vegetations-forschung auf Sociationsanalytischer Grundlage" (Studies of Vegetation on the Basis of the Analysis of Associations) published at Berlin in 1930, page 412, refers as follows to the point method:—

If we carry to its logical conclusion the development of quadrat methods in the direction of ever smaller quadrats, as we have followed it above, we come to the substitution of points for quadrats. A. H. Cockayne and Bruce Levy have done this, and have devised a method for the exact analysis of New Zealand pastures, which may conveniently be called the New Zealand point method. . . . The point method has been worked out for the analysis of the field-layer, and obviously is not concerned with the higher layers. It has the great advantage over many other methods that the vegetation of the investigated area is very little damaged. It gives a higher exactitude in comparison with the method of counting individuals and the line and strip methods, inasmuch as personal opinions are not forced on the worker. In the analysis of the field-layer it has an advantage in exactitude over the quadrat method, since a differentiation of even the densest species is rendered easily possible. Also the needles disturb the natural lie of the plant-shoots much less than does the quadrat, and the method removes the difficulty experienced in the quadrat method of projecting the different plant-shoots of the often dense field-layer on to the superimposed quadrat system.

The point method requires no more time than the other exact methods, apparently less. In my opinion it has good prospects of becoming the generally used method in the future for exact field-layer analysis.

—(Translated from the German by Dr. H. H. Allan.)

A modification of the New Zealand point method has been applied also by Bertil Lindquist in his treatment of the field-layer communities within the Scandinavian beech forests. An account is contained in his paper "Den Skandinaviska Bokskogens Biologi" (The Ecology of the Scandinavian Beech Woods) published in *Svenska Skogsvårdsföreningens Tidskrift*, Häfte 3, 1931. The following extracts are pertinent to the methods:—

P. 203: Since one of the chief aims of this work has been the study of the correlation between the field-layer synusia and the habitat, it has naturally been necessary to analyse the vegetation of the field-layer by the use of a method that as regards exactitude and objectivity corresponds as much as possible with the one that had naturally to be used in the study of the habitat. I have therefore not thought I should content myself with the more extensive method prevalent in Scandinavia of estimating the frequency of the different species by the help of the five-graded cover-scale (Hult, 1881; Sernander, 1894, 1900, 1921, &c.; Du Rietz, 1921, 1930). Concerning the hitherto existing methods for exact analysis of the field-layer, it will be sufficient to refer here to the recently published critical synopsis of Du Rietz (1920, pp. 400-414). Since not only the method of weight-analysis, but also the planimeter method of determining the grade of cover given by the different species tested by Skottsberg (1929) suffer from the fault that the results attained do not stand in reasonable proportion to the work involved (Skottsberg, 1929, p. 60), I could only concern myself with the different methods of exactly determining the density.

Of these methods I found, like Du Rietz, only that evolved by A. H. Cockayne and B. Levy—the point method—to give satisfactory results in the analysis of the field-layer.

On the basis of the principle of this method, therefore, I worked out a new method that I have used since the spring of 1929 in my analyses, in place of the Hult-Sernander and Raunkiaer methods that I had used previously.

Instead of the line-frame with 10 rods used by Cockayne and Levy, a quadrat frame 1 by 1 metres in area, with 100 rods evenly spaced over it, was used. . . . Points in this square frame were obtained by an arrangement quite comparable with that of Cockayne and Levy. From a horizontal bar descended 10 rods evenly spaced. This bar, which rested upon two legs attached to the square laid out on the ground, was movable along two sides of the square. In the analysis is first registered the vegetation at the 100 points, so that the bar has to be moved ten times along the sides, holes marking the exact place for each reading. It has not been practicable to bring the "points" down to the smallest possible size. After various experiments with different diameters I decided to use rods 3.5 mm. diameter, because it was difficult to obtain thinner material that would withstand the shocks the apparatus is liable to in use.

It must be emphasized that results thus fully comparable to those published here can only be obtained by using rods of the same diameter. Rather different results should be obtained if one worked with a rod-diameter approaching that of a mathematical point.

To be capable of registering a tall herbaceous vegetation the rods were made 1 m. long. With this apparatus I was thus able to determine the frequency of the species coming within the square, which is given by the number of rods (1-100) touched by each species.

After this exposition of the manner of using the new method, and of its possibilities, I think that without further investigation it can be used for plant-sociological purposes, especially as the mean error in registration seems somewhat small. In the researches I have carried out by this method since 1929 it has shown itself in all respects extremely useful.

Perhaps the chief advantage of the method lies in the fully objective nature of the work. It gives, moreover, well differentiated frequency determinations for every species. . . . This gives us now, for the first time, the power to follow in detail and with full objectivity the development of a test area from day to day, from year to year. It facilitates further the determination of mixed occurrences of species that because of their outer similarity can with difficulty be separated in the non-flowering condition—e.g., *Anemone nemorosa* and *A. ranunculoides*. . . . Finally, it should be an advantage in the method that the analysed plant community is in no way damaged in the investigation. The method has, however, certain disadvantages. In a community rich in species an analysis of this kind takes a rather long time, from a half-hour to an hour.

—(Translated from the Swedish by Dr. H. H. Allan.)

William Davies has also referred to the point method in his paper "Methods of Pasture Analysis and Fodder Sampling," Report No. 1, Welsh Plant Breeding Station, University College of Wales, Aberystwyth, 1931.

CONCLUSION.

The point method has been in use in New Zealand for eight years. The first published analyses made by the method are contained in an article by the senior writer, "The Grasslands of New Zealand," *N.Z. Journal of Agriculture*, Vol. 34, pp. 147-148, 1927; further references may be found in the same *Journal*, Vol. 35, pp. 363-374, 1927; Vol. 37, pp. 117-121, 1929; and Vol. 40; pp. 363-385, 1930.

It has been the intention of the writers to prove mathematically and statistically that the point method is sound. In order to do this, particularly in reference to the lesser constituents of the sward,

an enormous amount of data would be necessary, and time has simply not permitted such data to be obtained. The practical application of a method and the testing of it by mathematical formulæ are two different things. Numerous requests by overseas workers for greater detail of the point method as used in New Zealand have led to the publication of this article without statistical evidence of its soundness. We would commend such a work to any worker better equipped with time and facilities to carry out statistical investigations of that kind.

HAIRY FIBRES OF THE ROMNEY SHEEP.

III. CURLY-TIP FIBRES.

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THE main struggle with hairiness will be directed against the medullation of curly-tip fibres. The halo-hairs and hairy sickle-fibres (*Journal*, January and March, 1933) are more arresting objects in the coat of the young lamb, but greater danger lurks in the curly-tip fibres, which at birth appear so harmless. When these fibres are hairy they can put into the shade the hairy fibres described in the earlier articles, and in the big majority of sheep with hairy fibres at all abundant it is with the curly-tip group that the fault lies. Curly-tip fibres are always present, forming the great bulk of the birthcoat, but it is a consoling fact that they may be completely non-hairy.

There are great variations from lamb to lamb in the size of the curls, and in the number of the curls in corresponding fibres (Figs. 1 and 2). Where the curls are very big the tips of the largest fibres tend to be rather coarse. The largest fibres may have some medulla in the pre-natal region, and this may be coarse enough to make part of the tip appear chalky (Fig. 2, *b*).

In the earlier articles there was much to report about the shedding of the birthcoat kemps. The shedding of curly-tip fibres in early life is negligible. Very small numbers of tiny loose fibres have been found, and are called "baby" and "infant" curly-tip fibres because they are believed to correspond to the small sickle-fibres similarly named. Shed chalky curly-tip fibres, matching shed chalky sickle-fibres, have been found in a good many lambs; usually very few are shed, but sometimes both shed curly-tip fibres and shed sickle-fibres are quite numerous. These shed curly-tip fibres are among the coarsest of their group.

The description of crisis thinning in the previous article (pp. 148-150, with Fig. 9) is applicable to the large curly-tip fibres in many wool specimens. Substitute a curly-tip without a sickle at the end in the three fibres there shown and the figure would equally well illustrate what often happens in large curly-tip fibres.

Except in wool which is to be very fine, that part of many of the curly-tip fibres which is grown very soon after birth is appreciably thicker in normally developing lambs than the fine tip region. In wool from some lambs the similar thickening described in sickle-fibres

does not make its appearance quite so soon as in curly-tip fibres. This post-natal region may or may not be medullated. While it is not the only important phase to be watched for hairiness in the career of a curly-tip fibre, it is a most critical stage.

TRANSITION FROM HALO-HAIRS AND SICKLE-FIBRES TO CURLY-TIP FIBRES.

The transitions in structure by which halo-hairs and sickle-fibres are linked with curly-tip fibres are now to be described. This sketch will show how varied may be the characterization of a hairy fleece, even when the halo-sickle group is left out of account. It should be emphasized that while the facts to be recorded are likely to find some application as a basis for selection, they are likely to be of greater value indirectly by leading to an understanding of the interplay of forces that gives us hair instead of pure wool.

In contemplating the transitions from halos and sickles to curly-tips the order in which the types begin to grow is to be borne in mind. From the study of unborn lambs by Miss Galpin, together with the examination of specimens taken at birth, it is concluded that, probably with some slight overlapping, the halos and sickles begin to grow before the curly-tips, and that the more curls there are in the pre-natal part of a curly-tip the earlier it begins to grow. For the names adopted for the several distinctive series, or fibre type arrays, in which the fibres of different lambs' wool specimens can be arranged, I am indebted to Mr. K. M. Rudall. These names are taken from topographical features. They give some expression of the pictures that the fibre type arrays present to the mind. It is intended to deal with these arrays in more detail in the next article.

Sometimes a direct transition can be traced from halo-hairs to curly-tip fibres. In this array, called "Plateau," many fibres classed as curly-tip fibres have medulla in greater or less amount in the pre-natal region, but the characteristic sickle-end, narrowing to the non-chalky fine neck, is not found. This array is very rare on the back and side, but is frequently encountered on coarse britches.

When chalky sickle-fibres are present the transition from them to the coarsest curly-tip fibres may follow either of two paths. The simplest passage is a direct one, the sickle-end gradually decreasing in size along the series, until such an end can no longer be distinguished. If all the sickle-fibres present are chalky, the array is called "Saddle." In the "Ravine" array fine fibres, with sickle-ends on the whole of medium size, are included within the sickle series.

In the "Valley" array (Fig. 1) the route from chalky sickle-fibre to coarsest curly-tip fibre is less direct. The sickle-fibres with the smallest sickle-ends remain fine after birth and the transition is to fine curly-tip fibres with more curls in the tip than any other fibres of their group. They are called "checked" curly-tip fibres. Proceeding along the series we then meet coarser fibres with fewer curls, the coarsest being termed "peak" curly-tip fibres.

In all the arrays the series is extended by curly-tip fibres with successively fewer curls in the tip, progressively finer in the part grown following birth. In the "Plain" array, a modification of "Valley," there is comparatively little difference in diameter between

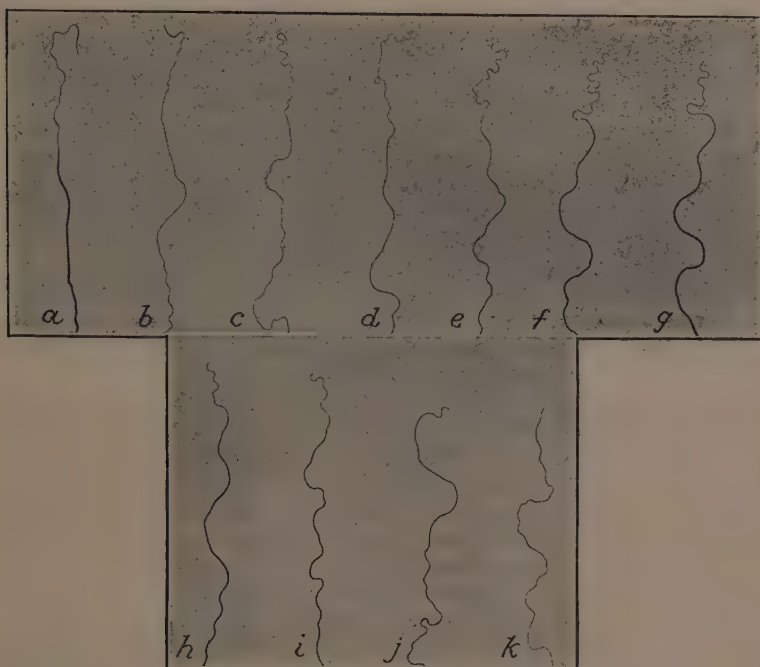


FIG. 1. SERIES OF FIBRES TO ILLUSTRATE THE "VALLEY" ARRAY. (DIAGRAMS SLIGHTLY LESS THAN ACTUAL LENGTH.)

a, Chalky sickle-fibre; *b*, *c*, fine sickle-fibres; *d*, *e*, checked curly-tip fibres, fine; *f*, intermediate between fine checked curly-tip fibre and peak curly-tip fibre; *g*, peak curly-tip fibre, chalky; *h*, *i*, *j*, curly-tip fibres with progressively fewer curls and successively finer; *k*, non-curly-tip fibre, fine. The fibres are so placed that the birth point, at the base of the curly tip, is at about the same level in those figured side by side. These fibres, and those of Fig. 2, are from the standard position on the back.

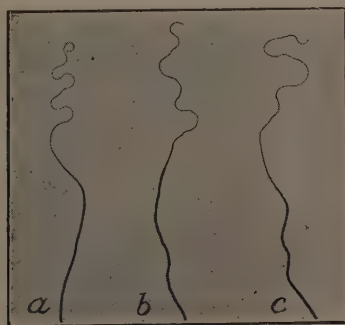


FIG. 2. LARGE CURLY-TIP FIBRES FROM THREE DIFFERENT LAMBS, WITH THE CURLS LARGER THAN IN FIG. 1. (DIAGRAMS SLIGHTLY LESS THAN ACTUAL LENGTH.)

the fine sickle-fibres and the coarsest curly-tip fibres, so that this evenness extends over a good part of the curly-tip section of the array, and often far along the series.

THE PRE-NATAL CHECK.

It is hoped to show more clearly in the next contribution how these several fibre-type arrays may be regarded as the differing expressions of the pre-natal check, a restricting force acting before birth to which reference was made in the last article. We may look upon the fine sickle-fibres and the checked curly-tip fibres as more affected by this depressing force than the coarser fibres near to them in the array. In the Valley array it frequently happens that the finest sickle-fibres are finer than any of the checked curly-tip fibres, and, while the really fine checked curly-tip fibres may be present in numbers comparable with the fine sickles, the latter are generally the more abundant. The very fine fibres of these two groups have mere specks of medulla or none at all. The peak in the curly-tip series may, however, come rather late, so that marked effects of the pre-natal check extend for some distance along the array.

Peak curly-tip fibres, especially when they come early in the series, occupy a commanding position among hairy fibres, both for coarseness and rapid growth. Sometimes they make a sprinkling of chalky fibres in a piece of wool otherwise non-hairy. Both by Mr. R. Waters and myself they have been found to sustain their growth particularly well in lambs with coats growing very badly during the autumn or winter. Non-hairy peak curly-tip fibres are recognized in some curly-tip series that are free from hairiness.

VARIATIONS IN THE HAIRINESS OF CURLY-TIP FIBRES.

The myriad variations that exist in the hairiness of curly-tip fibres can be stated in terms of the position of a type in the array, but it is not at present intended to do more than indicate further ways in which wool specimens may differ. From the preceding section it will be evident that arrays differ greatly in the portion of the curly-tip series in which coarse medulla, or it may be medulla of any kind, is present. The distribution of medulla along the curly-tip part of the array is not haphazard, and only one continuous section of the curly-tip series is affected. It may be, at one extreme, the whole series that is hairy, at the other extreme none, or almost any portion of the series, longer or shorter, save that it is never only the shortest-tipped fibres that are affected. Those with very short tips are never the hairiest members of the series; usually they are not more than slightly medullated.

There are great differences in the distribution of medulla along the length of the fibres. This applies to different members of the curly-tip series of the same wool specimen, and to corresponding types on different parts of the same animal or on the same region of different animals. Variations in sickle-fibres medullated after birth are very similar to those in curly-tip fibres. On the whole, those medullated persistent fibres that are coarsest just after birth sustain their medulla farthest towards the butt, and it is in these same fibres, if there be a suspension of medullation in the winter, that medulla

most readily reappears. One gets a very good idea of these variations by examining specimens from hoggets at shearing time in benzol. Medulla may extend right to the butt of specimens from the back or side or for any shorter distance. When medulla is well sustained there is often a marked reduction of medulla about the third month owing to crisis thinning, and if hairy fibres are comparatively few there may be a complete absence of medulla in this region.

In many lambs medulla stops at the crisis level, and it is a common happening for abundant medulla to extend a little beyond this point to become reduced very soon afterwards (Fig. 3, *b*). Often medulla is produced for but a short time after birth, ceasing definitely before the crisis level. If medulla ceases at the crisis level, or at some lower level, there may or may not be a revival of medulla at the butt end in the spring before shearing, but this restoration of medullation has not been found if medulla stops before the crisis level is reached. It is already clear that the point on the staple to which medulla extends is a feature to be considered in foretelling the hairiness of later fleeces. Curly-tip fibres are not uncommonly found with three medullated regions, one grown after birth, one after the crisis region of about the third month and before the height of the winter, and one before the time of shearing, separated by intervening portions free from medulla. Counting the pre-natal part some sickle-fibres with a similar career after birth have no fewer than four separate medullated sections. Within such clearly defined regions there may be short pure wool portions where one cannot pretend to say just why medulla is absent. Such fluctuations are found especially where the medulla is fine.

Mention may just be made of one further type of variation. As can be judged from examinations in benzol, the same region of corresponding types in different specimens may differ in the diameter of the medulla, and in the ratio of medulla diameter to total diameter, and medulla may be broken instead of continuous. The presence in some fibres of extremely small fragments of medulla is a feature which also may merit attention. It is to be repeated, however, that most of these details are not being put forward as a basis for action on the practical side. They are to be thought of rather as providing an accurate basis for experiment, and as clues to be followed in various directions.

FIBRES WITHOUT CURLY-TIPS.

Curly-tip fibres are followed in the array by fibres without definite curls in the tip. These begin to grow in considerable number about the time of birth. They are always fine compared with the coarser curly-tip fibres, but very occasionally, when the curly-tip fibres at their end of the array are hairy, they contain enough medulla to appear chalky to the eye.

Other fine fibres begin their development at different times after birth, and on present evidence it appears probable that any hairy fibres beginning to grow later than about the time of birth are the successors of other hairy fibres that have been shed.

THE TWO GROUPS OF HAIRY FIBRE TYPES.

Two of the figures which illustrate this article have been chosen in order to emphasize that the hairiness of birthcoat kemp and the

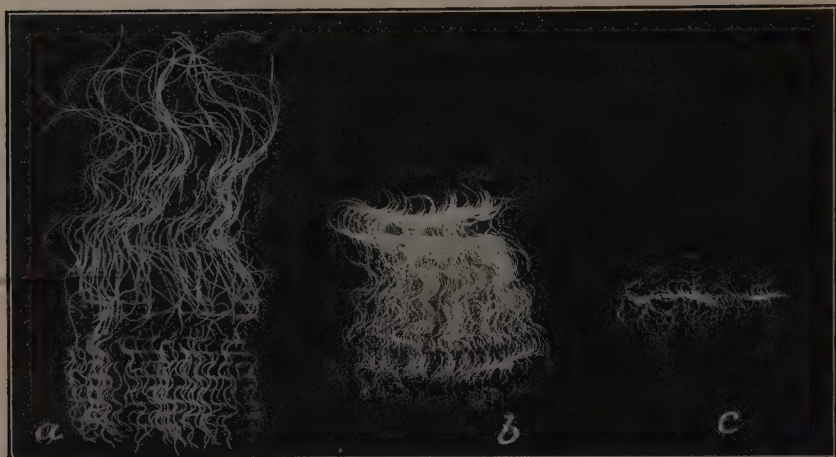


FIG. 3. PHOTOGRAPH OF WOOL SPECIMENS, IN BENZOL, FROM THE BACK OF LAMBS ABOUT FOUR MONTHS OLD. (ABOUT HALF NATURAL SIZE.)

In *a* the hairy fibres are all of the halo-sickle group, or are the successors of these fibres. In *b* the hairy fibres are all of the curly-tip group; medulla ceases a little below the crisis level. In *c* the hairy region is very short. The cut butt of all three specimens is at the same level.

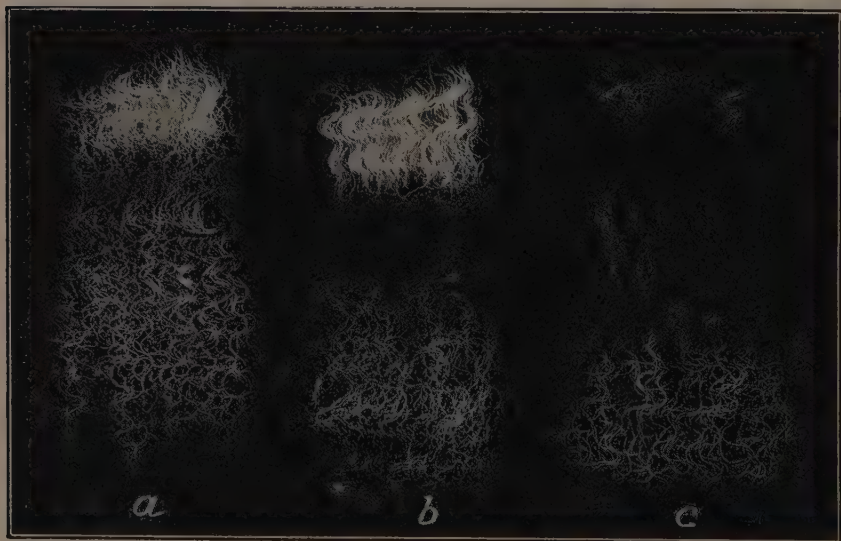


FIG. 4. PHOTOGRAPH OF WOOL SPECIMENS, IN BENZOL, FROM THE SIDE OF LAMBS ABOUT SEVEN MONTHS OLD. (ABOUT HALF NATURAL SIZE.)

In *a* and *b* medulla is well sustained towards the butt; *a* has an appreciable reduction of medulla in the crisis region; in *b* the crisis region is long and very free from medulla. In *c* there is only a little medulla in the part produced while the lamb thrived poorly in the early months, but more in the basal portion grown when the lamb was making better progress.

[Photos by P. McMahon.]

hairiness of curly-tip fibres are two distinct things. Fig. 3, *a* shows wool in benzol with all the curly-tip fibres non-hairy, while halo-hairs and chalky sickle-fibres and their successors are abundant. Fig. 3, *b* shows a specimen in which neither halos nor chalky sickles could be found, but with many medullated curly-tip fibres. Both kinds of hairiness may be in evidence in greater or less degree in the same sample, and in many Plateau arrays a general lustiness is common to both groups of fibres, but the independence of the two kinds of hairiness is to be stressed.

INHERITANCE OF THE HAIRINESS OF CURLY-TIP FIBRES.

No accurately planned breeding experiments on this kind of hairiness have yet been conducted, and to study its inheritance will assuredly be a complex business. A few points may be reported from some very rough experiments. The birthcoat of many of the sheep used had not been seen, but when hairy fibres are very numerous it is safe to assume that curly-tip hairiness predominates. Many of the specimens were stored without examination before the phenomenon of "collapse," to which he at first referred as "infilling," had been discovered by Mr. B. L. Elphick.* I am much indebted to him for the advice which has compelled me to reject certain material, but in certain of the experiments the results were ascertained from fresh specimens taken from sheep sampled in the thorough manner advised by him. In comparing parents and offspring, the animals of the younger generation often had to be judged on specimens taken at an earlier age than those from the members of the older generation.

To the details of the development of the fleece in the second and subsequent years little attention has yet been paid, but it is clear that the hairy fibres of later fleeces are mostly the continuations of curly-tip fibres of the birthcoat. Preliminary evidence indicates, conveniently enough, that the degree of hairiness of a standard position on the side of animals kept in similarly normal conditions each year is very largely the same in each of the first four fleeces. It is true that the later fleeces may be coarser, and their hairiness more readily detected by eye, and medulla may be better sustained towards the butt of the staple, but the abundance of medullated fibres appears to be much the same. Exceptions have been searched for, and it will not occasion surprise if others are discovered, but the only kind of exception so far found is that now to be described.

Sometimes it happens that the second fleece, and also the third, are less hairy than that of the first year. Thus if the medulla of the side is confined to a short apical region, as in Fig. 3, *c*, the same part of the second fleece will sometimes have less medulla or none at all, and on the back there may be a proportionately greater reduction in hairiness. This matter it is hoped to study in some detail, for it is of obvious practical and theoretical interest.

When the wool of both parents was very coarse and hairy the big majority of their lambs resembled them in this respect. These lambs were on the average much hairier than the lambs produced in various matings between less hairy sheep. A very few lambs were

* *Journal of the Textile Institute*, XXIII, 1932.

less hairy than their parents, differing from them in one or other of the ways in which it has been explained that curly-tip fibres may vary in hairiness.

In experimental matings, made for other purposes, between animals that proved to have only moderate numbers of hairy fibres, a few lambs were obtained much hairier than either parent. That this may happen will not be novel information to breeders. Generally such lambs were coarser-woolled than their parents, though this does not appear to be so in every instance. In detailed researches in other countries it has been calculated that fibre diameter must be determined by a large number of hereditary factors. It is clearly an easier matter for a fine fibre to be non-hairy than a coarse fibre, but there is reason to believe that in the Romney medullation is influenced also by genetic factors other than those determining fineness or coarseness. In matings between animals with few hairy fibres and animals with many the offspring often had many, but a few lambs, with wool comparatively fine, had fewer hairy fibres than either parent. The details of the inheritance of curly-tip hairiness will prove very complicated, but that hairiness is primarily a question of breeding hardly requires argument, for differences between breeds are so great, and so are those between well-grown Romney sheep raised together.

NON-GENETIC FACTORS AFFECTING THE HAIRINESS OF CURLY-TIP FIBRES.

Several lines of evidence show that the production of medulla is influenced by non-genetic factors, and that the response of the skin is sometimes a very sensitive one. Medulla production is often to be associated with vigorous growth. First may be mentioned the measurements of Mr. Waters and Mr. Elphick, who found freedom from medulla in that layer of the fleece of certain animals which was grown very slowly in the winter, while there was much medulla in the parts grown more rapidly before and afterwards. In some of these fleeces the slowly grown wool was exceedingly fine so that it showed the condition ordinarily described as a "break."

The results of the differential shearing of moderately hairy animals are also to be cited. Some twenty full-mouth ewes and ten hoggets were shorn in the spring on one side but not on the other, and in the great majority the wool grown during the succeeding two months was perceptibly more hairy on the shorn than on the unshorn side. Several other old ewes were on one side machine-shorn in the ordinary way, and on the other side shorn at some 2 in. above skin-level. Again, in some of these animals the wool grown under the covering of the couple of inches was appreciably less hairy than that produced on the side shorn to the skin. In this work Mr. Elphick, with his critical eye for samples in benzol, was good enough to check my conclusions. Mr. Waters and Mr. Rudall will shortly present more detailed results from experiments on similar lines.

Evidence of the effect of malnutrition upon the hairiness of young lambs has recently been obtained. A number of lambs grew very badly for the first two months or so of life, or for part of that time, as was shown definitely by weighings made at intervals, with some improvement afterward. Wool specimens from the back and side of

these lambs were examined in benzol. Some of these lambs were very hairy, and in their fleeces medulla production proceeded along usual lines. In fifteen out of sixteen slightly hairy lambs picked out on their weight records as having grown badly, in specimens from the side or back, or from both positions, the distribution of medulla along the length of the staple proved to be unusual, or following a thin region there was a thickening without medulla at an unexpected time. For example, medulla would appear in the usual way immediately after birth, but soon cease, well before the crisis level, to revive again in the third or fourth month (Fig. 4, *c*). One specimen showed three separate bands with reduced medulla in the wool of the first four months. In others there would be a delay after birth before any medulla appeared. Very possibly, too, the unusual length of the crisis region shown in Fig. 4, *b* was the result of the poor progress of the lamb. Where medulla faded out or revived in these unusual ways the fibres became thinner or thicker as the case might be. In lambs that grew well any similar happening was very rare, and any such temporary reduction in medullation was very slight indeed. In lambs making normal progress medullation starts very soon after birth, and, if it ceases altogether at any level in the staple, does not revive in the early months of life, except in some of those lambs in which medulla is sustained to the crisis level. There may then be an absence of medulla for a short length of the staple owing to the coarsest fibres becoming thin and non-hairy for a time instead of being shed (Fig. 4, *a* and *b*). It is thus clear that in many lambs growing poorly medulla was not produced in certain regions at times when it would have been formed had the animals been growing faster. At many points in the specimens from the badly grown lambs it would appear to have been touch-and-go whether medulla was produced or not. It would seem that it does not take much to tip the balance one way or the other.

DISCUSSION OF FACTS PRESENTED.

In conclusion, the facts that have been presented will be briefly considered from practical and theoretical points of view.

The experiments here reported, coupled with those described before on the inheritance of kemp, lend support to the common-sense belief that selection against any kind of hairiness should be as keen as possible in choosing both rams and ewes.

The facts recorded in this and the earlier articles have some bearing on judging animals for hairiness at different ages. Kemp can be observed at birth or, very conveniently, at docking time. If in any part of the coat curly-tip hairiness has not appeared at the average age of docking there is a very good chance that it will never be present in that region. If curly-tip hairiness is present on the side, but ceases before the crisis level, there is considerable hope for later fleeces; but if this hairiness is still being produced there at weaning time the animal is to be distrusted. More specific advice will be made possible by the study now in progress of the relation between the first and later fleeces.

Prominence has been given in this article to the non-genetic factors that play a part, as yet not measured, in making wool hairy.

When we bear in mind, therefore, that breeding is not everything in determining the degree of hairiness, it would seem reasonable not to attach too much importance to slight differences between one sheep and another. Again, if animals that have been exposed to unfavourable conditions show up well in freedom from hairiness, these conditions, as breeders recognize, may largely be responsible for the purity of the wool. In order to disentangle the effects of heredity and environment upon the hairiness of curly-tip fibres it will be necessary to solve intriguing problems.

Attention has already been drawn to the need for understanding the interplay of forces that determines whether a fibre is hairy or not. It must be our aim to build up a theory of medullation. Consider a fibre that is pure wool when growing slowly, but medullated when growing faster. The forces available for producing keratin, the substance of which pure wool is composed, are then clearly not equal to converting the whole of the output of fibre material into pure wool. No doubt the work done so far focuses attention more upon differences in output of fibre stuff from the skin than upon differences in power of keratinization. It is possible that a change in this power has taken place in the passage from the first year to the second year in animals that are hairy at the tip of the staple of the first fleece, while the second fleece is free; but this argument must not be pressed, for in the early weeks of life the fibres are densely crowded, and it may be that the output of material per unit area at that time is very high. The most arresting evidence for the existence of inborn differences in keratinizing power is seen when certain lustre and hairy mountain British breeds are compared, and in the results of crosses between these breeds where the influence of the lustre side in reducing hairiness is very powerful.

Finally, the conviction is to be stated, as a working hypothesis, that keratinizing power in the sheep with which we are dealing is on the whole low, and this is probably true of many breeds. I suspect, further, that many animals which show up well in freedom from medulla are like candidates that have just scrambled through an examination with little to spare. To my mind our real objective in combating hairiness in "crossbred" wool must be the recognition of sheep with a reserve capital of keratinizing power. To the solution of this problem, attacked from many angles, our best efforts should be directed.

ACKNOWLEDGMENTS.

This research was helped by support from the Department of Scientific and Industrial Research.

My thanks are due to Mr. P. McMahon for the photographic work.

Mottled colour in salted butter is usually to be considered as due to different layers of butter having water globules of different sizes. For example, if large crystals of bluestone (copper sulphate) be compared with the finely powdered crystals, the latter will be observed to be a much paler shade of blue. So in the butter the paler layers have in them much smaller and better distributed water globules (or, in the case of salt butter, brine globules). Uniform distribution and size results in uniform colour, and this is no doubt facilitated by the preliminary revolving of the churn with rollers disengaged.—*Dairy Division.*

CELERY-SPOT AND ITS CONTROL.

J. C. NEILL, Field Mycologist, Plant Research Station, Palmerston North.

CELERY is notoriously a difficult vegetable to produce satisfactorily. In reasonably good garden soil it grows well in most parts of New Zealand, but is almost invariably attacked by celery-spot (*Septoria Apii* Chester). When this happens the plants soon assume a "blighted" appearance—the outer leaves becoming covered by multitudes of small irregular spots (Fig. 1), and finally turning brown and dying off. The younger central leaves become infected in turn, so that the plants remain stunted and unthrifty, and, since the severity of the attack increases with the advancing season, seldom produce stalks fit for the table.



FIG. 1. CELERY LEAF SHOWING THE CHARACTERISTIC SPOTS OF THE DISEASE.

[Photo by H. Drake.

Commercial growers, and amateurs who are sufficiently fond of celery to take the necessary trouble, keep the disease in check by spraying at intervals of about three weeks, from the seedling stage onwards, with Bordeaux mixture. This method is quite effective if carried out regularly, the best formula being 3 lb. bluestone, 4 lb. hydrated lime, 50 gallons of water. By substituting washing-soda for the hydrated lime—at any rate in the later applications—less of the objectionable blue spray deposit is left on the stalks. Prevention is, however, with this as with other diseases, better than cure, and fortunately it is quite practicable to prevent the appearance of the disease by the adoption of certain precautions.

To carry out these precautions intelligently it is necessary to have some knowledge of the life history of the causal fungus. If an affected leaf is examined it will be seen that on each diseased spot there is present a group of small pin-head black dots. These dots are the fruiting organs of the fungus, each one of which liberates a great number of extremely minute spores. These spores are carried in rain splashes and by insects to neighbouring leaves and stems, and there germinate, penetrate the tissues, and rapidly form new diseased areas which in turn produce more spores. Thus the infection process proceeds with ever-increased velocity, until every part of the plant is covered with the disease spot and the new heart leaves are attacked before they have a chance to develop.

If the disease is present on plants reserved for seed the fungus establishes itself on the flower-stems and outer coat of the seeds themselves. An examination of most commercial samples of celery seed under a good magnifying glass will disclose here and there a seed on which can be seen the characteristic black pin-head fruiting bodies of the fungus; they are most readily seen on the small stalks still carried by some of the seeds (Fig. 2). These infected seeds are the means whereby the fungus is carried to the new crop.

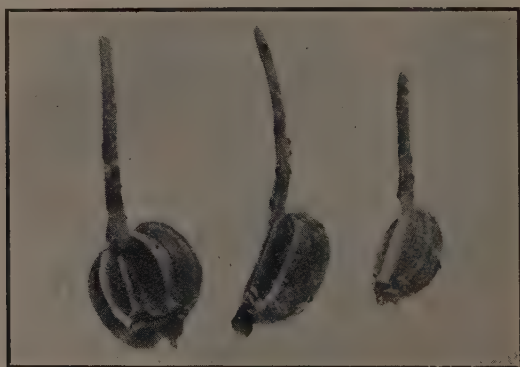


FIG. 2. INFECTED CELERY SEED (MAGNIFIED).

The small black protuberances, seen most clearly on the stalks, are the fruiting bodies of the causal fungus.

[Photo by H. Drake.

The first precaution, therefore, to prevent the disease is to make sure that the seed to be used is free from infection, or, since this is not usually possible, to render it so by artificial disinfection. Several methods have been advocated for this purpose, but, in general, have usually failed to give the complete freedom from the disease which is essential for successful control. During the past eight years an intensive study has been made at the Plant Research Station on the problems of seed disinfection. In nearly every case of seed-borne disease yet studied the most reliable agent for disinfection has proved to be hot water. The method by which it is applied varies with each kind of seed and with each disease, but prolonged experimentation has nearly always shown that it is possible to disinfect by hot water without prohibitive damage to the seed itself.

On these lines an investigation into the possibility of disinfecting celery seed from the celery-spot fungus was commenced last winter. The laboratory results were so promising that during the summer field trials were carried out of a hot-water method thus evolved. These field trials—subject to confirmation by further experiments next season—showed that it is quite possible to obtain a stand of first-class celery, free from celery-spot, from diseased seed treated by this method, without any spraying of the plants, when seed from the same packet, sown untreated, produced a heavily diseased and quite worthless crop. Fig. 3 shows fair average samples of the two crops. Four varieties were used in the experiments and the results were identical with each.



FIG. 3. CELERY GROWN FROM SEED TAKEN FROM A SINGLE PACKET.

Centre plant from hot-water-treated seed ; outside plants from untreated seed.

[Photo by H. Drake.

On these results the method can be confidently recommended for trial by celery-growers, provided the instructions which follow are carefully and intelligently carried out.

PRACTICAL INSTRUCTIONS FOR THE PREVENTION OF CELERY-SPOT.

Seed Treatment.—This consists in dipping the seed for ten minutes in water held at exactly 136° F. Directly on removing from the dip the seed must be plunged in cold water and held there for at least two minutes. The seed should next be thoroughly and rapidly dried, and can then be kept in the ordinary manner till sown. This treatment will cause the seed to be rather slower in germination, with a loss of about 10 per cent. compared with the same seed when sown untreated, provided the seed is not over one year old. Two-year-old seed will lose about 50 per cent. of its possible germination, and three-year-old

seed will probably be almost entirely killed. It is, therefore, very important that fresh seed only be used and that a preliminary trial be run with a small quantity before treating the bulk, in order that the effect on germination may be tested.

The seed for treatment should be tied loosely in a cotton netting material of a mesh just small enough to prevent the seed from escaping. It is a good plan to place a few pebbles in the bag with the seed in order to prevent the bag floating, since the seed must be below the surface during the whole period of the dip. A large volume of water* should be used in comparison with the quantity of seed in order to assist in keeping the temperature steady. The thermometer should be compared before use at 136° with a standard instrument; many thermometers are very inaccurate, and it is imperative that the temperature of the treatment should be correct.

Raising the Seedlings.—Celery seed is usually sown and the seedlings pricked out in boxes held in a glasshouse or frame. If previously used for this work the soil, boxes, and frame or glasshouse itself may harbour spores capable of reinfesting the plants from clean seed. Soil from old compost heaps should never be used. If steam-sterilized soil is not available, then it is best to use a mixture of old pasture loam and clean sand. New seed-boxes should be used, and the frames, &c., thoroughly sprayed with formalin 1 pint to 10 gallons some weeks before use. Since infection with celery-spot is almost impossible to detect on the seedlings, entire reliance must be placed on these precautionary measures. They must, therefore, be thoroughly and intelligently carried out.

Private gardeners, who usually buy their seedlings from nurserymen, are strongly advised to sow treated seed either in a clean box or in place. The latter is the safer method if weed seeds and slugs are not too abundant. If looked after and thinned early the plants will do better than forced seedlings, though perhaps be a little later in maturing. The main thing is to avoid the almost certain infection with celery-spot that is carried by purchased seedlings.

Every care must be taken that no part of last season's celery crops can come in contact with the new bed. Celery-spot, in fact, is a dangerous and highly infectious disease of the celery plant, and should be guarded against accordingly.

A close watch should be kept on the plants for an accidental infection, in which case the infected plant should be removed and the whole bed immediately sprayed with Bordeaux mixture. Destroying the infected plant alone will not eradicate the disease, since, by the time the disease can be seen, the spores have almost certainly been distributed on to other plants where they will germinate and create fresh centres of infection. The Bordeaux will prevent this if all parts of the plants are coated with a protective covering of the spray.

Potato Flavour in Butter.—Some butter made recently at an Otago dairy factory from fresh cream had a peculiar flavour resembling the odour of raw potatoes, and the butter would have been second grade if sent forward for export. A similar flavour caused trouble some years ago at another factory, and was traced to feeding raw potatoes to cows.

BLOSSOM-END ROT OF TOMATOES.

ITS APPEARANCE, CAUSE, AND PREVENTIVE TREATMENT.

E. E. CHAMBERLAIN, Mycological Laboratory, Plant Research Station,
Palmerston North.

BLOSSOM-END ROT is in New Zealand the most serious fruit-rot of tomatoes, both in the glasshouse and the field. It has a world-wide distribution, since it has been recorded from practically every country in which tomatoes are grown. The disease was first recorded for this Dominion by Kirk in 1896, under the various names of "tomato fruit-blight," "tomato-rot," and "tomato black-rot." He attributed the disease to the fungus *Macrosporium tomato*. In addition to those listed by Kirk, this disease has been given many additional common names such as "black-rot" (Galloway, 1888), "blossom-end rot" (Whitehead, 1896), "point rot" (Selby, 1897), "fruit-rot" (Stone, 1911), and "black-spot" (Carne, 1926). Cunningham (1922) listed the disease as "blossom-end rot," this name being both descriptive of the symptoms and that generally used by overseas workers.

Blossom-end rot has been reported from every tomato-growing district in New Zealand. It is more prevalent in some seasons than in others, and occasionally may cause heavy losses in individual crops, since the affected fruit is unmarketable.

SYMPTOMS.

The disease first appears as a water-soaked area at or near the blossom end of the immature fruit. This water-soaked area, which may be quite small or may involve half the fruit, rapidly darkens until within one or two days it has been replaced by a brown or even black lesion. In the early stages the shape of the fruit remains normal and the lesion occurs merely as a darkened area (Fig. 1), but as the fruit grows the lesion becomes depressed (Fig. 2), the affected tissues collapsing and becoming hard and leathery.

The dead tissue is frequently attacked by secondary saprophytic organisms, and it is quite common to see on the lesion in an advanced stage of the disease a dark velvety growth due to *Alternaria* or *Cladosporium* (Fig. 2), a white mycelial growth due to *Fusarium*, or a glistening wet growth of bacteria. In the absence of secondary organisms, and when the lesion is small, the rot does not extend very far into the fruit, but when the lesion involves as much as half the fruit, or when blossom-end rot is followed by a secondary attack of *Fusarium* or bacteria, the rot may extend throughout the whole fruit.

CAUSE OF BLOSSOM-END ROT.

Although blossom-end rot was known and had been recorded previously, Galloway (1888) appears to have been the first to study the disease and to give a description of its symptoms. He isolated both a *Macrosporium* and a *Fusarium* from the diseased tissue, and considered that the rot was due to the former, which he thought



FIG. 1. BLOSSOM-END ROT OF TOMATOES.

An early stage of the disease on tomatoes grown in the glasshouse, showing how even the very small fruit may be affected. About three-quarters natural size.

[Photo by H. Drake.

was a wound parasite. Since then the cause of blossom-end rot has been attributed to several different organisms: *Cladosporium lycopersici* (Whitehead, 1896), *Fusarium* (Elizabeth H. Smith, 1907), and bacteria (Stone, 1911). As early as 1897 Selby concluded that the rot was brought about by lack of moisture in the soil. Brooks in 1914 showed experimentally that "blossom-end rot of tomatoes is not due primarily to either bacteria or fungi." Most subsequent investigators have accepted this view, realizing that the various fungi and bacteria isolated are of a secondary nature.

In New Zealand several fungi, such as *Cladosporium* and *Alternaria*, and also bacteria, have been found associated with the disease in the advanced stages. These organisms are, however, by no means always present, for in some instances it has not been possible to isolate any organism even when the fruit has almost completely rotted.

CONDITIONS UNDER WHICH BLOSSOM-END ROT APPEARS.

The work of Brooks (1914) showed that continued excessive watering or a sudden check in the water-supply produced blossom-end rot, and that healthy, vigorous, fast-growing plants were most susceptible to the disease. He found that nitrogenous manures such as sulphate of ammonia or blood manure, in which the nitrogen was present in the form of an ammonium compound or

which were capable of forming ammonia, increased the incidence of the disease irrespective of their effect on the growth of the plants. Nitrate of soda containing an equivalent amount of nitrogen did not have this effect. He also showed that certain varieties were more susceptible to blossom-end rot than were others, but, as Reynolds (1918) has since pointed out, even the most resistant varieties may, under certain conditions, show a high percentage of infection.

In this country it appears that the disease is usually due to lack of moisture, since the condition generally occurs in the field when the plants are grown on light sandy soil, being often confined to dry, sandy or gravelly ridges. Crops which have been regularly irrigated and are then left for a period without water suffer the heaviest losses. Vigorously grown sappy plants are the most susceptible.

Experiments carried out at the Plant Research Station have demonstrated that blossom-end rot occurs in the glasshouse only under certain conditions. It appeared when vigorous plants with well-developed fruit were removed from a shaded to an unshaded glasshouse, while it did not occur on similar plants left in the shaded house.

PREVENTIVE TREATMENT.

(1) The plants should be provided with an adequate and regular supply of water, especially after the fruit has begun to develop.

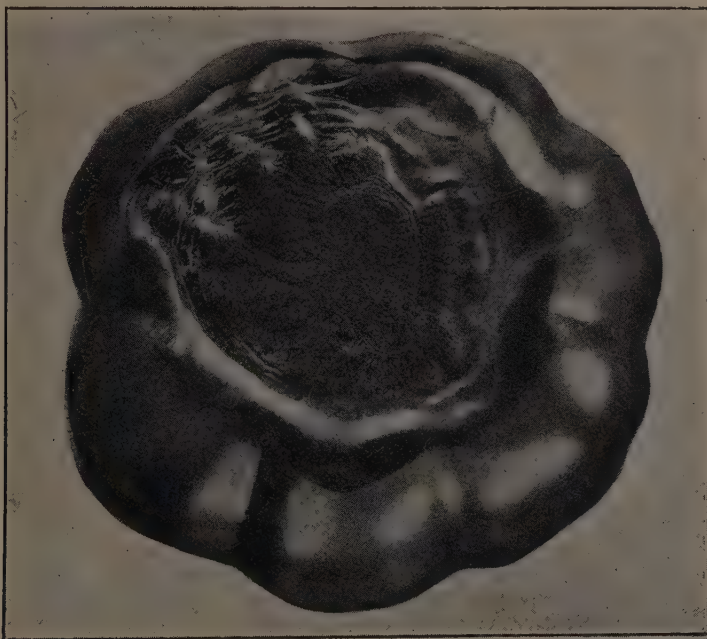


FIG. 2. AN ADVANCED STAGE OF THE DISEASE ON OUTDOOR GROWN FRUIT, SHOWING THE DEPRESSED LESIONS WITH A DARK VELVETY GROWTH OF ALTERNARIA ON THE SURFACE. NATURAL SIZE.

[Photo by H. Drake.

(2) The soil should be well cultivated for the conservation and even supply of water.

(3) A steady growth of the plants without any check should be aimed at and forcing avoided, particularly where dry conditions may be expected during the fruiting period.

(4) Nitrate of soda should be used as a nitrogenous manure in preference to sulphate of ammonia or blood manure.

(5) In the glasshouse the disease may be checked by shading the plants by an application of whitewash to the glass.

(6) When growing tomatoes in the field, light sandy soils and especially sandy ridges should be avoided.

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CHEESE CAPS AND CAP CLOTHS.

J. B. SAWERS, Dairy Division, Palmerston North.

THE condition of the crowns of cheese is a point which is at times liable to be overlooked, more especially when the rinds are in good condition. Instances of cracked crowns which have come under my notice have been caused through the rough caps being put on dry and cold, instead of being taken from a bucket of scalding water. If the rough caps are not kept porous and clean by daily washing there is a possibility of the crowns being cracked or open. Factories dressing the cheese in the morning instead of the evening have to be very careful to apply good hot rough caps.

The white cap cloths in use vary a good deal so far as quality is concerned. Some are more closely woven than others. Cap cloths have come under my notice where there are too many weak spots caused by the threads being not woven together closely, and there is nothing to prevent a crown cracking at those points. The cap should be sufficiently wide to take a good grip of the crown near the edges.

The weakest portion of a green cheese is on the crown and edges, and when cheeses are removed from the hoops and are being carried to the curing-room the crowns and edges have often to stand a fair amount of strain.

In my opinion the use of a stronger and closer woven cap cloth of not less than 14 in. diameter, together with the proper use of the rough caps, would strengthen the crowns of the cheese and make them less susceptible to cracks.

SEASONAL NOTES.

THE FARM.

Economy consistent with Efficiency.

THE difficult economic situation appropriately has given rise to an intensive search for every possible means of reducing farm expenditure. One important consequence of this is a great danger of reductions in expenditure being the causes of greater reductions in returns, so that eventually the financial position becomes worse than it would have been had such reductions in expenditure not been made. In this connection the field work required for the most profitable feeding of our farm stock is of current importance, for such work should be planned without delay if this has not already been done.

In contemplating any reductions in farm outlay it should be remembered that an outstanding weakness in our farming has been the poor feeding of our stock. If our past feeding practice had been of a higher standard there might have been scope for reduced effort consistent with the maintenance of efficiency. As our feeding practice commonly did not completely fulfil the profitable requirements of the stock there cannot generally be economic scope for reduced provision of feed, and, in general, unless there has been a reduction in stock, the primary aim of the farmer should be to provide at least as much feed as formerly.

Pasture top-dressing, because of the dominance of grassland in our live-stock industry, has been an important factor in the cheap provision of feed, and, to the utmost limit possible with the funds available, reduction in top-dressing should be avoided. It is especially incumbent on those who find it necessary to reduce their former top-dressing programme to consider alternative means of maintaining the feed supply at the same level without the same amount of direct outlay. Some of the most important measures which may be adopted for this purpose and which will soon call for attention are grass harrowing, ensilage, and special cropping. Regarding ensilage and special cropping, which are discussed later, it is well to keep in mind that though they may serve to some extent to replace top-dressing as a means of feeding stock they cannot similarly serve to feed the pastures, which may be expected to deteriorate to an extent corresponding to the extent that top-dressing is reduced.

To sum up, on those farms on which outlay on top-dressing is necessarily curtailed every effort should be made to take full advantage of practices which call for little or no direct outlay. During the coming season, in keeping with this view, often attention may be given advantageously to grass harrowing of a more thorough nature and at more frequent intervals than has been followed in the past, to the construction of ensilage trenches or pits, and to tillage in preparation for special crops.

Pasture Harrowing.

THE fact that a pasture is not to be top-dressed as freely as formerly makes it all the more desirable to obtain the fullest possible benefit from the fertilizing material supplied to it in the form of animal manure. Almost invariably harrowing of pastures is not carried out often enough to secure the fullest fertilizing effect from the animal droppings. If droppings have remained undisturbed long enough to lead eventually to the development of patches of rank growth, then there has occurred not merely waste of potential fertility, but positive harm from it. Such waste and harm can be avoided only by more frequent harrowing. The point of current importance is that to many farmers who possess both harrows and the

horse-power to draw them more frequent harrowing will not involve more direct outlay, but it will lead to a better feed supply.

Ensilage.

While a substantial expansion in ensilage has occurred in recent years, there is still scope for much further profitable expansion along lines which will call for little or no direct outlay, especially on the part of those who have already installed modern ensilage equipment. On many farms the sweeps, &c., already on hand could profitably harvest more material than has been harvested in the past, when, although some silage was saved, much feed, nevertheless, was allowed to go to waste, leading to the development in midsummer, throughout many countrysides, of hundreds of acres of coarse, stemmy growth. Such stemmy growth not only is unfitted to yield the best possible results with dairy cows and breeding ewes, but also is likely to lead to deterioration of the swards themselves, whereas saved as silage without any great direct outlay it would be very valuable during the customary critical periods of feed shortage.

In respect to such ensilage the function of the pit and of the trench, which are growing in popularity, should not be overlooked. The value of the pit as a means of minimizing labour and wastage of material in ensilage has long been known, and each year recently has been providing many additional instances of silage being taken from trenches with a minimum of waste. As it is preferable to have pits and trenches made some time before they are to be used, their construction is as a rule work which well may be undertaken during winter months. On many farms it is impossible to select completely suitable sites, but on most farms, apart from those which are very wet and low-lying, it is possible to find sites which will serve quite well for pits of which serviceable types can usually be made without any outlay on material. Further information about pits and trenches is available in Bulletin 146, obtainable on application.

Among sheep-farmers especially is the scope great for the adoption of ensilage. Mainly because their need for it has not been so acute, sheep-farmers have lagged behind dairy-farmers in the exploitation of ensilage as a means to improved pasture utilization. Especially in the sphere of fat-lamb production there is abundant field experience in the Dominion indicating the value of ensilage to sheep-farmers.

General Pasture Work.

On many farms certain pastures are more suitable than the others for providing late winter and early spring feed. These are the paddocks which are well drained, covered with a sward containing a considerable amount of rye-grass, and possibly also provided with some shelter. A special effort should be made to top-dress and to harrow such paddocks in good time, as the additional early feed thereby obtained is likely to be specially valuable.

If certain pastures are showing evidence of current infestation of grass-grub, then, when possible, hay and roots should be fed out on them; the grubs suffer from the consequent additional trampling, and a certain amount of resowing of seeds contained in the hay may occur where plants have been destroyed and assist in strengthening the damaged swards.

It is as a rule inadvisable to apply soon after each other lime and any of that group of phosphates which are chemically alike, and which include raw rock phosphates, Island and African. These phosphates are relatively low in availability and slow in action, and become more markedly so as a rule when their application is associated with recent liming. The use of lime and fertilizers on pastures was discussed at some length in March and April notes.

In many districts pastures, especially those containing a substantial amount of rye-grass, if closed towards the end of May or early June, will

provide valuable fresh feed in late July and August. The amount of July-August feed obtainable in this way may be increased by the use of a nitrogenous manure such as sulphate of ammonia, from which the results are best when used in conjunction with phosphates, and which are likely to be disappointing if nitrogenous fertilizer alone is used. Whether the use of nitrogenous manure in this manner would be profitable requires to be considered carefully in the light of the present prices of farm produce.

Special Supplementary Crops.

In the crops commonly grown to supplement grassland, such as mangels, chou moellier, turnips, and rape, as a rule heavier crops than those ordinarily obtained would prove more profitable after making due allowance for the extra effort needed to secure the heavier yields. This is accounted for by the fact that the main heavy items of cost have to be faced whether the crop is merely a medium one or a really good one. The cost of land, of seed, of some manure, of ploughing, harrowing, disking, drilling are the same for a 25-ton as for a 50-ton per acre crop. If the extra outlay on manure and cultivation needed to produce the extra 25 tons is not as great as the whole cost of producing the smaller crop, then the heavier crop is the cheaper source of feed.

It is of seasonal importance that one of the main factors limiting crop yields is insufficient tillage, particularly before and also after the sowing of the seed. Under many circumstances it would be well to begin at this season the preparatory cultivation for such crops as those mentioned above. However, during that preparatory cultivation two deep ploughings, such as are sometimes recommended, are not always advisable; the surface layers of old swards at times carry a heavy population of weeds and their seeds. A first deep ploughing will bury these. A second deep ploughing will bring them back to the surface layer where they will be likely to give trouble in the growing of the crop. There is no good reason for bringing them back to the surface provided a sufficiently good seed-bed can be obtained in some other manner. Many find that the necessary seed-bed can be secured by skim ploughing and disking well ahead of sowing, thus pulverizing the surface soil, which is later turned down deeply by a full ploughing and not subsequently disturbed. In order to place all the weed-infested surface layer well underground it is at times of value to use on the plough a suitable skimmer attachment, thus lessening the development of weeds which occasionally occurs between the furrows.

In many parts of New Zealand the factor which definitely limits yield, especially in the case of crops such as mangels and potatoes, which are capable of high yields, is the supply of soil moisture during the growth of the crops. This fact is one reason why in drier districts it is advisable to begin the preparatory cultivation for these crops in good time. Early working enables the rain to sink in more readily and to be held in reserve for the use of the crop. The importance of building up a soil water reserve in this way is illustrated by the fact that in the growth of a 50-ton crop of mangels at least 2,000 tons of water an acre passes from the soil through the leaves of the crop. This amount of water is equivalent to 20 in. of rainfall. In those districts in which 20 in. of rain do not fall during the growing season of the mangel early cultivation obviously is highly desirable as a means of augmenting soil reserves of moisture.

When the soil is not too wet and cold oats and barley may at times be sown with success in June to provide useful spring feed. Such crops should not be drilled deeply, and usually will respond profitably to a dressing of 1 cwt. to 2 cwt. of superphosphate per acre. Seed treatment should be carried out as with earlier-sown cereal crops.

Crop Utilization.

The winter feeding of stock on roots alone is undesirable in that it gives a diet too watery and cold, and one likely to set up digestive disturbances. Roots when supplemented with dry fodder such as hay or chaff give best results.

The feeding out of swedes on land which shortly will be sown in turnips, rape, or swedes, should be avoided, as it may readily lead to contamination of the land with club-root and dry-rot organisms. Fortunately, mangels and carrots are not likely to pass on crop diseases.

Some guidance in the feeding of silage is provided from the fact that 1 lb. of grass silage equals in feeding value approximately 2 lb. of roots, and 2 lb. to 2½ lb. of grass silage is equal in feeding value to 1 lb. of good average hay. Preferably animals should not be called upon to support themselves upon silage alone, which should be used to supplement pasture, just as hay or roots are ordinarily used in that way. Under New Zealand conditions it should seldom be necessary to attempt to feed to dairy cows more than 40 lb. daily, for usually smaller amounts will suffice in conjunction with the feed provided by the pastures. Silage has been fed with good results to sheep, when used to supplement pastures, at the rate of about 2 lb. daily.

Especially if the land occupied by the mangel crop is intended for another crop, such as oats, the pulling and storing of mangels should now be given attention. However, if the mangels are still growing and they are not to be fed until August or September, it is doubtful whether it is advisable to pull them early in June unless the land they occupy is required for some other crop, or likely to become so wet later that it will be difficult to cart the crop off. Freshly pulled mangels cannot stand frost as well as those which have been pulled for a few days. Hence to avoid frost injury, if at all possible, a spell of broken mild weather should be selected for the task of pulling. Many sheep-farmers are successfully utilizing mangels without storing them. Customarily, broken-mouthed ewes are turned in to eat off the tops, and the roots are then harrowed out in breaks some days before the sheep are given access to them. The feeding takes place later on in the season when the mangels, before being dislodged, have undergone a certain amount of natural ripening.

General.

Implements should be kept at work as much as possible preparing land for spring sowings of cereals and root crops. Often lea land can be worked without injury when land which has been under arable crops is too wet.

In general, winter proves the most suitable season in which to attend to farm drainage. Special care should be taken to see that blockages do not cause poor working of drains already in existence. In new drainage work, even in respect to land badly drained, money may easily be wasted if the work is not properly planned.

—R. P. Connell, *Fields Division, Palmerston North.*

THE ORCHARD.

Autumn Planting of Fruit Trees.

THE immediate important autumn and early winter work outlined in last month's notes, if not already completed, should now be hurried on.

Autumn planting of fruit trees should be carried out as early in May as possible, while the weather is fine and the ground warm and friable. On the other hand, should this month prove wet and the ground become sodden, it is advisable to postpone planting until such time during the following spring as soil and climatic conditions become favourable. In the

latter case the trees will require to be heeled or bedded in without delay. To do this, dig a trench in a moist but well drained soil, putting the soil taken from the trench at the back, and place the trees singly in the trench, the tops resting in a leaning position on the soil placed at the back. Cover up the roots with loose pulverized soil banked half-way up the stems. The trees will stand in this position without detriment until required for planting.

Before heeling in, certainly before planting, the trees should be dipped in a solution of red-oil, 1-10, as a safeguard against insect pests and their eggs, such as red-mite, woolly aphis, mussel scale, &c. Dipping is preferable to spraying in so far as it is more thorough, but care must be taken to prevent the solution from reaching the roots.

In laying out the ground the exact position of each tree should be marked with a stake. For this purpose a builder's chain or thin wire rope with the distance apart of the trees marked with coloured wool is to be recommended. A line of rope or twine should not be used, as it is easily stretched and the stakes are then placed out of alignment.

Before planting, the rooting system of the trees should be carefully examined and all damaged roots cut off with a sharp knife or secateurs above the injured portion; likewise all thick strong roots should be cut well back. As a result of such cutting adventitious roots so essentially necessary for the re-establishment of a strong rooting system are formed. Perhaps the most common cause of failure is planting too deeply. As a general rule, if the soil in which the tree is planted is similar to that from which it was taken, the tree should be set the same depth as it was before removing from the nursery row. If the soil is heavier the tree should be set a trifle shallower; if lighter it should be planted a shade deeper.

The holes for fruit-trees should be more than wide enough (the wider the better) to permit of the spreading of the roots. It should be convex in the centre, or of the shape of an inverted saucer. This is done by heaping up loose sweet surface soil in the hole so that when the tree is planted its base stands a little higher than the roots, which should spread in a natural position, radiating outwards with a slight dip downwards. A handful of bonedust or some other phosphatic manure, or, better still, either sulphate or muriate of potash worked with the earth around the plant, will provide nutriment for the young rootlets and ensure the rapid growth of the tree. The trees for planting should remain heeled in until actually required for placing in their permanent position; and then only a few uncovered at a time so as to avoid excessive drying of the roots.

The essence of successful planting is to plant firmly and to ensure that the contact of roots and earth is as close as possible. Every endeavour should be made to avoid air pockets round the roots, as these are very liable to cause drying-out and generally retard growth; they are mainly caused by leaving lumps of earth unbroken. The tree is placed on the slight mound in the hole, and, as soon as the correct alignment has been obtained by taking sights both ways on the trees already planted or on stakes marking the positions of unplanted trees a small quantity of fine, sweet surface soil should be shovelled and tamped gently round the roots. Repeat until the roots are firmly and well covered. The remainder of the hole may then be filled up and the soil trodden firmly round the tree, with the exception of the last shovelful or two, which should be left untrodden.

Winter Pruning.

Pruning is the major winter operation, and generally speaking, should be commenced as soon as possible after leaf-fall. In districts of a temperate climate, however, it is not advisable to prune too early, as a warm spell of weather is often experienced during the winter months, which has the effect of exciting early-pruned trees into premature growth liable to be subsequently destroyed by a late frost.

Growers should arrange their work so as to finish pruning (including the gathering-up and burning of prunings) and leave a safe margin of time for the late dormant spray to be applied before the new season's growth commences. Stone fruits being the first to start growth each season are usually pruned before pip fruits.

—J. W. Whelan, *Orchard Instructor, Palmerston North.*

Citrus Culture.

The autumn months this season have been very favourable for citrus trees of all kinds. In most localities a good deal of wood growth has been made and this is continuing. It must be recognized that such growth will be very tender and liable to be injured by frost. This period is now approaching, and growers who are in areas where damaging frosts do occur are well advised to use some method of protecting their trees.

One method is to procure benzine tins, take off the top, and cut a vent in the bottom. Some kind of quick-kindling material is then placed in the bottom and the top filled with coal. These tins are placed in sufficient numbers through the orchard some time before frosts are anticipated. They are covered to prevent water getting into and damping the material. When the nights are indicating a frost which is likely to cause damage, a torch is used for lighting them. Only about half are lit at first, and, should it be necessary, the remainder can be lit a little later. By this means the temperature is raised just sufficiently to prevent damage.

Another method is to have pots made of fairly heavy material that will hold about 1 gallon of crude oil. Each pot is provided with a lid, by which any rain is kept from the oil. The lid also provides a means of extinguishing the burning oil if it is not all required during any one night. A small oil torch can be procured, which serves the purpose of lighting the oil in the pots. The crude oil can be procured from one of the oil companies and costs about 6d. per gallon. The pots can be made locally at about £8 per 100.

After all danger of frost is past for the season, the tins or pots can be taken into the shed and kept in readiness for future use. It is necessary to drain the oil from the pots and put it back into large barrels that it is supplied in. The empty pots then stack up into a very small space. The tins containing kindling material and coal can be taken in just as they are and stacked up in a dry shed ready for the following season.

The cost of either operation is not great in comparison with what the loss might be in a commercial orchard should a succession of sharp frosts occur.

—L. Paynter, *Orchard Instructor, Auckland.*

POULTRY-KEEPING.

Management of the Breeding-birds.

It is now quite time that the breeding operations were planned, for it is always a safe rule to be well prepared and to have everything in readiness at mating time. Reference is here made to early hatching—i.e., to the breeding of birds for autumn and early winter laying. Hatching operations should not commence before July, as birds of the heavier breeds hatched then will come on to lay on the rising egg market. While this is so, preparations for this important work should be got under way now.

In the first place, special attention should be directed to the feeding and management of the prospective breeding-stock in order that they may be specially attended to. The food for the hens that are to occupy the breeding-pens should be of a different character from that supplied

to the laying pullets, or even the hens which it is not intended to breed from—that is, if the breeding-birds are to be in a proper condition at the time of mating. It is important that these birds be kept by themselves in order that they may be specially attended to. The great aim should be to maintain the birds in a perfectly healthy state, but at the same time every care should be taken that they do not get into an overfat condition, as it is well known that good hatchable eggs and strong chicks cannot be produced from an overfat breeder. It is true that there is little danger of overfeeding the good layer with the right class of food when she is in laying condition, but this does not hold when she commences to moult and ceases to lay. Obviously if she is provided with an abundance of rich stimulating food when not laying, and while there is no tax on her system in the production of eggs, the formation of surplus fat has every encouragement. As already indicated, this should be avoided at all costs; the birds should be well fed but not overfed. From now on the birds should be frequently handled, and if there is a tendency for them to put on surplus fat the ration should be slightly reduced.

The breeders should also be encouraged to exercise as much as possible, so as to prevent the storing-up of body fat. The aim should be to maintain them in what may be termed a lean, hard condition. To achieve this it will generally be found a wise policy to provide at all times a ration of hard grains such as wheat, oats, maize, &c., and as a rule the greater the variety of food provided the better will be the fertility of the eggs and the stronger the chicks. The grains should be fed in deep scratching material, in which the birds should be made to work for practically every grain of food they receive.

Reference is now chiefly made to cases where the birds are kept in confined quarters. When a good range is available, or, better still, a free range, nothing can take its place. In this way the birds not only secure natural exercise, but natural food as well—two essentials for the maintenance of good health. Usually hens during the moulting-period, and until they are nearing laying point, are disinclined to take exercise, and as a result, when provided with abundance of food, such as a mash mixture which is easily obtainable, they are encouraged to sit on the perches and grow fat. Thus the object of a whole-grain ration fed in deep litter is to keep the birds busy as a means of preventing the storing-up of bodily fat.

Particularly where a free range is available, there is no objection to giving the birds a light morning mash, provided this is not of a forcing character. On no account should high egg-laying records be looked for from breeding-birds, or weak progeny will be the result. Thus meat, milk, or other forcing food should be fed with caution. At such a time birds cannot be oversupplied with green material, while crushed sea-shell, gravel grit, and clean water should be within reach at all times. With hens that are being kept for egg-laying alone there is not the same objection to their getting into a more or less fat condition, for the reason that when nearing a laying point they can be forced for egg production, with the result that the amount of surplus fat will soon be reduced to a minimum—that is to say, if they are of a special egg-laying type.

I would again emphasize that if the breeding-hens are in an overfat condition, due to being provided with the wrong class of food, or through lack of exercise, not only will there be a high percentage of infertile eggs, but trouble will also be met with in the hatching and rearing of the chicks produced.

In the feeding and management of breeding-hens many lessons can be taken from birds that live under natural conditions and are not interfered with by man. It will be found that the great majority of birds under such conditions commence their breeding operations after the leanest

period of the year—the winter—when food is most scarce. In addition to this the work of making their nests tends towards preventing an accumulation of body fat. It is an old saying in connection with breeding operations that the further we get away from nature the nearer we get to trouble, and therefore it would appear to be a wise course with the breeding-hen to follow nature as closely as possible.

A mistake often made is to endeavour to patch up for the breeding-pen a bird that has apparently recovered from some disorder. It is always a risky matter, and the mistake, of course, is discovered when it is too late. A hen that has been affected with some trouble may recover sufficiently to more than pay for her keep, but such a bird is better kept out of the breeding-pen. The worst mistake that can be made in this connection is to use for the renewal of stock a male bird that has had its health impaired at any time. A weakness probably remains, and it therefore has not the stamina necessary to ensure the production of healthy offspring. I have seen many cases of weak stock which could not be successfully reared as a result of using doctored breeding-birds. To ensure the most satisfactory results there must be no question as to the constitutional vigour possessed by the parents.

Mating.

Now that the prospective breeding-hens—the late moulters—have renewed their feathers and are preparing to commence their season of production, it is well to mate them up without delay. Mating up the breeding-pens is undoubtedly one of the most important phases in the poultry-keeper's year and one which calls for his keenest judgment if profitable stock are to be secured. It is often considered that the incubation and brooding stages are of chief importance, but these are only links in the chain of management. The quality of the parents is the chief consideration in successful poultry-keeping. The keen poultryman will carefully study his breeding operations, and will be guided by the sound principles upon which the successful breeding of all stock rests. The ABC of this is that like produces like, and that no stock can be too good to place in the breeding-pen.

In recent issues of the *Journal* advice has been given regarding the type of bird most desirable for the breeding-pen, and too much importance cannot be attached to the fact that if a heavy-producing strain is to be built up or maintained it is imperative that the breeder shall have an ideal type to aim for, pictured in his eye, and select birds conforming to this type accordingly. Egg-record alone will never achieve this end, as the most productive hen is not always the best breeder. If this were so the breeding of birds to a desired egg-producing standard would be as simple as it is now difficult. It is never a wise course to place in the breeding-pen a freak type of bird, however good a layer. If desired characters are to be maintained in a strain it is only the type which has been bred true to a given ideal from generation to generation which has the power to transmit desirable characters. The breeding-hen should certainly be a proved good layer, but she should also possess trueness of breed type. Further, only birds which conform to standard weight requirements and those which lay a good-sized marketable egg should be bred from. Not only should the back be broad, but there should be a great depth of body, well developed in front and in the abdominal region. Above all, the breeding-bird should possess maximum points indicative of strong constitutional vigour, such as tight feathering, clean face, prominent eyes, well-developed crop, and an active business-like appearance.

Do not forget that the male is more than half the flock. He should be the offspring of a heavy-producing mother, have plenty of "timber"

about him, undoubted constitution, and be masculine in every respect. One of the best certificates of health in a male is a glossy well-kept plumage.

—*F. C. Brown, Chief Poultry Instructor, Wellington.*

THE APIARY.

Winter Precautions.

BEFORE the cold weather sets in every hive should be examined in order to make sure that the frames are completely covered with sufficient dry well-fitting mats to keep the bees protected. Wherever a damp or mouldy mat is discovered it should be replaced with a dry one, and the roof examined and repaired. No draughts should be allowed around the frames. Mats made of corn-sacks cut to the exact size of a zinc queen-excluder answer all requirements of warmth. Be sure they are placed in their exact position. If placed crookedly the edges are apt to be pushed out between the hive-body and the roof, and will in time absorb enough moisture to make them damp and unwholesome.

Once more the time approaches when the necessity for shelter should impress itself on the beekeeper. It is most essential that the bees be protected from cold winds during the winter. Should no permanent shelter be available, something temporary should be erected—if the bees are expected to prove in normal condition in the spring. Manuka scrub is excellent for making a temporary wind-break.

Weeds and grass should be kept down. A good clearing round the hives in autumn will suffice until spring, and will add materially to the comfort of the bees and the well-being of the hives. Not only should the entrances be cleared, but the ground all round the hives similarly treated, and the weeds raked up and destroyed.

Care of Hives.

At no other season is the welfare of the hives of such importance as during the next few months. Every hive should be raised from the ground to the height of one brick, and if the situation is damp or low-lying it is a good plan to raise the hives still more. This will tend to keep them free from slaters (wood-lice) and other insects, and will afford less harbour for mice, as well as ensuring that the hives have a free current of air beneath the bottom-boards and are thus more likely to keep dry. Never rest the bottom-boards on the ground, or they will rot in very short time and become mouldy and evil-smelling.

Before bad weather sets in it is a good plan to give a coat of paint wherever it is needed, at the same time stopping up all cracks in the supers. Cracks afford ventilation during the summer months, but they are hardly to be advocated on that account, because the beekeeper will usually find that towards the end of the honey-flow the bees will use much valuable time in gathering propolis to paste up the cracks in view of the approach of winter. The hives should be slightly canted forward, so that any rain which falls on them will drain off the alighting-board.

Apart from disease, there is no worse feature in an apiary than the presence of leaky hive-covers. A roof which allows moisture to trickle through is a constant menace to the colony it appears to shelter. Not only will the mats immediately beneath it become sodden and mouldy, but the cluster of bees in the hive stands in danger of extermination when frost sets in. There is no excuse for leaky covers. In the autumn the apiarist should examine them for any doubtful spots, and should either cover them with zinc, ruberoid, or some other water-proof material. If

economy must be practised he may cover with cheesecloth, applying to the roof first a coat of paint, then the cheesecloth, and then another coat of paint. This makes an effective water-proofing, and one which anybody can apply.

Plans for Next Season.

During the off-season is the best time to make plans for the following season. The beekeeper should decide what increase he desires to make, and should prepare accordingly. Making up hives and frames is exasperating work if left till the bees are crying out for room, and it should be finished long before the actual time for increasing one's stock arrives. The beekeeper should also face the question of providing himself with stocks of foundation, and make arrangements for the treatment of his surplus wax by some neighbouring maker of foundation. He should also decide on which market to place his crop, and lay his plans accordingly. It is advisable, too, that he consider the theoretical side of his occupation, and, while the bees are in a dormant condition, study the best methods of improving his stocks. Neither weather conditions, locality, nor any other factor will influence the honey crop so much as strong colonies of bees, and the apiarist should endeavour, while he has the time, to ensure that these shall be in existence during the following summer.

—E. A. Earp, *Senior Apiary Instructor, Wellington.*

HORTICULTURE.

A Retrospect of the Past Season.

APART from some broad principles which have a very general application, the art of applying economically and effectively the science of the successful cultivation of plants demands close observation of local conditions of soil and climate and the careful adjustment of cultural methods to the needs of the crop. In important respects these will vary with the general soil and climatic conditions of the district; but they will also vary from season to season. One's methods also will vary widely, of course, according to the crop to be grown; but it is less generally recognized that the variety of the species grown also demands careful consideration, so widely do the habits and susceptibilities of one variety differ from another in many instances. In considering the cultural experiences of the past season, it is the difficulties and losses upon which the attention is naturally fixed, so that one may learn any lesson that experience has to teach.

Among important horticultural crops, growers of tomatoes have, in some localities, had considerable loss of plants during the past season from the disease commonly known as black-stripe. The most familiar symptom of this trouble is the brown or black sunken furrows on the main stem of the plant, and the brown discoloured pith, which in some instances cause the plant to wither up. On the leaves dark spots appear about the angles of the main veins, and on the affected fruits are round and irregular discoloured depressions, usually numerous and of moderate size. Infected plants are sometimes found in the seed-boxes, but more often the symptoms are not observed until the plant is half-grown and the fruit commences to ripen. The disease is said to be due to *Bacillus lathyri*, a fairly common disease of some peas and other legumes, as well as solanums; but the researches of other scientists have a tendency to indicate that a virus disease of some type is responsible. The doubt does not affect the grower very much, as the reactions are somewhat similar in either case.

Regarding virus diseases, a writer has stated: "There is a type of infectious disease attacking both animals and plants which, because of certain distinctive characteristics, is placed in a class of its own and referred to as a virus disease. This kind of disorder is due to an infectious entity the exact nature of which is not at present known. The infectious principle or virus, is characterized by the excessive smallness of its component parts, which are able to pass through a porcelain or collodion filter, the pores of which are too small to allow passage of bacteria. There are many such virus diseases." Instead of a localized attack on the plant on or near the surface, as in the case of most fungi, it increases and spreads interiorly with more or less rapidity, as do bacteria, and is therefore like it little influenced by the application of chemical sprays.

Such plant diseases are readily spread by means of (1) sucking insects, and (2) the operation of pruning. Bewley states the occurrence of the disease in the seed-bed suggests that (3) "the seed from infected fruit may also be infected, or carry the organism externally, though so far no actual proof of this has been obtained." Experience here rather endorses that view. In variety tests carried out by this Department tomato-seeds were obtained from different countries, and the heavy infection of stripe disease in some varieties, while main crops in the vicinity and other varieties in the test were quite free, created a strong impression that it might be seed-borne. There is also a very decided evidence (4) that the constitution of the plant affects its susceptibility to this disease. During the years 1919 and 1920 at Cheshunt Experimental Station trials were made to prove this point. Plots receiving a dressing of complete artificials without potash had 65, 88, 28, and 80 per cent. of the plants diseased respectively, while similar plots receiving a dressing of complete artificials without nitrogen had 28, 42, 16, and 23 per cent. of plants affected. The effects of "damping" (the trials were carried out under glass) and forced growth versus slow growth were also carried out with a result that was very similar, in that the forced plants were very extensively diseased. In this way it was proved that "plants growing rapidly in the early stages are more liable to 'stripe' than others of a hardier nature." Experience here and research in other countries endorses this conclusion.

In the light of these facts, what is the best way to reduce the percentage of losses from this cause in the future? (1) Avoid an overrich mixture in the seed boxes, and (2) high temperatures and humidity when raising young plants. This does not usually occur when raising plants now for the early crops under glass, but the crop for outside planting sown later sometimes suffers in this way during springtime pressure of work. During that period of changeable weather, glass frames and houses demand frequent attention, which should be the definite responsibility of a certain member of the staff. (3) Carefully consider the condition of land before planting out. If it has carried a crop of spring cabbage or lettuce which has been heavily dressed with sulphate of ammonia or other form of nitrogen, a liberal dressing of sulphate of potash will be necessary to avoid a comparatively high mortality from "stripe." (4) Should "stripe" appear in the crop it will generally be best to remove the infected plants and bury or burn them and apply a further dressing of potash at a rate of 5 cwt. per acre. If this happens during the early stages of growth the blanks may be replanted, or if the infection is high up in the plant it is sometimes satisfactory to cut away the top well below the visible point of attack and take up a new leading growth; but do not use the knife again without disinfecting it.

Treatment at this stage is very interestingly dealt with by Samuel, of the Waite Research Institute, who recommends as follows: When the earliest symptoms are noticed mark the plants but do not touch them until the end of the day. Then remove all marked plants carefully and burn

or bury them. Wash hands with soap and water and replant the blanks. Do not prune for a fortnight after the disease has been noticed, but continue to mark and replace each day. Seven to fourteen days is considered the incubation period of this disease.

Such management will go far in reducing the dissemination of the disease by the pruner; but (5) insect control is specially necessary where this disease is present; aphids and thrips are common agents in spreading such diseases. During dry seasons and in warm localities this alone may be the cause of a serious outbreak. Under glass these pests are readily controlled by means of fumigation, which should be done as soon as their presence is detected and repeated a week or so later to destroy the newly hatched young, as the eggs are not affected by the treatment. The tomato crop growing outside in a dry season is not so liable to the attack of fungus diseases, but sucking insects may be expected, and owing to the part they play in disseminating bacterial and virus diseases nicotine sulphate or kerosene emulsion should be used for their control. (6) Where seeds are to be saved for future use it is not advisable to select the fruits from a box, however fine they may be, but they should be taken only from a plant of approved type and after careful examination to ascertain that it is free from "stripe" or any other serious disease.

The tomato moth, which was the cause of considerable loss during the 1931 season, was kept well under control this year, in spite of the fact that the season was favourable to it. The dreaded bean-wilt disease also was avoided in a very commendable way. Two or three kinds of caterpillars took advantage of the fine weather and caused considerable loss where spraying was not done. The greenish-coloured caterpillar of *Plusia chalcites* was troublesome on beans, tomatoes, marigolds, &c., showing a very varied taste; and the speckled caterpillar of *Mecyna maoralis* did a surprising amount of damage to shrubby plants; but more serious was the loss caused by the dull-green caterpillar of the "white butterfly." In districts where only one or two specimens were seen the previous season it was very numerous, and a common sight in fine weather, but it seems to have practically disappeared towards the end of April. The cabbage crop, to which it is very partial, may possibly be safe so far as the spring crop is concerned; but the summer and winter crops will only be grown with difficulty where it is established. However, the natural parasite has been successfully introduced by the Entomologist at the Plant Research Station, and in a season or two the phenomenal spread of this pest should receive a check.

The Pruning of Bush Fruits.

Although this operation is not by any means confined to the winter months it has a special application now. Those who have not graduated in its mysteries should give the subject very careful consideration and practice, for if a good tree has been given the right environment correct pruning is generally the main factor in its success, whether the object be flowers, fruit, or just wood.

The subject readily becomes confusing, but consideration is here given to the pruning of hard-wooded small fruits. When young plants are set the immediate object is to obtain a reasonable amount of strong growth, so that a vigorous plant may be established so soon as possible. Suitable pruning is the most important means of bringing this about. If this single purpose and method are kept in mind there will be little or no confusion. To do what is purposed it is usual to restrict the growth to three good branches in the first year, and to encourage vigorous growth these are shortened back carefully, selecting terminal buds pointing in desirable directions. As these are the primary branches in the bush they should be strongly placed.

This method precisely is suited to such plants as red and white currants and gooseberries. When vines such as Chinese gooseberry or passions are planted and a single leading growth is desired, remove entirely all vigorous shoots but the one desired, and concentrate on this lead so long as it is desirable, carefully tying it to its support during the season to protect it from injury. The statement is to remove all vigorous shoots but the one desired, because those that are comparatively slender will not compete with the design and should be left to provide ample foliage, which is indispensable to the vigorous growth of the plant.

In the case of raspberries, loganberries, and black currants we have plants of a different character. Young plants of this class are cut back to within 6 in. of the ground to induce vigorous growth during the following season, but there is not the same scrupulous care about the design of the branches, as it is the suckers springing from the ground that bear the fruit next season. The black currant is somewhat of an exception to the rule that to maintain the branches in a fruitful state they must have ample light and air; so that there is not the same need to keep an open centre to the bush and space widely the permanent branches for that purpose, as in the case of gooseberries and other currants. Feijoa, guava, loquats, and other evergreens are usually pruned later in the season, just before growth may be expected to commence.

When plants of this class have been established for two or three years and sturdy plants are approaching maturity, one's object then is to encourage a heavy crop, and in doing this pruning is a most important means of bringing it about. It will be noticed that plants produce their fruit (1) on new growth made the same season, as does the passion vine; or (2) on last season's growth, as in the case of the gooseberry, black currant, and raspberry; or (3) on the old wood, as in the case of red or white currants. Such facts afford the cue to the pruning treatment of mature plants. In the first instance one will naturally cut back last season's growth to one or two base buds, as they are most likely to supply the vigorous new growth required to carry the crop. In the second instance, as the plants will produce fruit on last season's growth of good quality, the obvious treatment is to cut away anything else but that—except, of course, the permanent framework of the bush. Such treatment is quite correct, and if wood that has borne fruit and weak new wood are cut back, leaving just the last bud at the base, it will grow out while the other shoots are cropping, and one has desirable wood to follow on for cropping another season. In the third instance little pruning will be needed probably in established bushes if vigorous unnecessary growth was suppressed during the summer as it appeared. The bushes of this class are very apt to become overcrowded with strong sucker growth or terminal wood induced by unsuitable heading back. If these were not removed completely so soon as they appeared it should be done now.

These are the main points in pruning such subjects, but in each instance the plant must be kept under control, or disease, pests, and poor fruit will be the result.

The Homestead Garden.

The remarks on pruning in the foregoing paragraphs have an application here. How often one sees a vigorous wistaria in a good moist rich loam that is suitable for its finest development, a sprawling futile thing that is always in the way. When the young plant is established only one of the more vigorous shoots should be allowed to grow, and this, running up like the magic "bean stalk," should be carefully tied in for support. When it reaches the desired height, and horizontal growth is desired, "stop" the shoot and three or four strong laterals will appear; tie in those that are required, and cut out the others completely. In this way one builds up an orderly plant quickly and quite simply. The only danger perhaps is in

doing it too quickly, in which case it will be poorly furnished with flowering laterals and spurs. For that reason half or two-thirds of the growth is cut away each winter until it almost reaches its full extent. A well-trained wistaria or bougainvillea in flower is an arresting sight that will afford great pleasure.

The rose generally comes in the class which bears its blossoms on the young growth of the same season, and is pruned accordingly; but as the young growth of so many varieties is killed by hard frosts it is necessary in districts where they occur to defer the operation until spring really commences. The fragrant white Banksia and the yellow Banksia are species of roses introduced from China. Their brief beauty is much appreciated, but as the flowers are produced on last year's growth—usually laterals of moderate length—they should be pruned so soon as they have finished flowering in the spring by cutting the flowering shoots back to the base buds. The Wichuriana rambles have a somewhat similar habit, and the canes should be cut out completely after flowering. They throw new canes freely from the base, and these should be tied in, to flower the following season. Some favourite shrubs in this class are Weigelas, Forsythias, Philadelphus, lilacs, and honeysuckles.

The preceding paragraph deals with the pruning of established plants which have reached maturity. Young plants of most kinds newly planted must be studied and pruned to maintain vigorous growth until maturity is approached and to form a well-spaced framework for the position to be occupied. The amount of supervision necessary will vary; conifers, rhododendrons, heaths, &c., will generally require least, and deciduous hardwood plants most; but this attention, however much or little may be needed, is most important to good development.

—W. C. Hyde, *Horticulturist*, Wellington.

FERTILIZER IMPORTATIONS: MARCH QUARTER.

FOLLOWING are particulars of importations of fertilizers into New Zealand for the quarter ended 31st March, 1933:—

Nitrate of soda: Chile, 342 tons. *Basic slag*: United Kingdom, 6,490 tons; Belgium, 9,058 tons. *Phosphatic guano* (soft phosphate): Seychelles Islands, 3,194 tons; New Caledonia, 2,007 tons. *Rock phosphate*: Ocean Island, 22,982 tons; Nauru Island, 31,444 tons; Tuamotu Archipelago, 2,253 tons. *Other phosphates*: Belgium, 3,455 tons; Netherlands, 650 tons. *Kainit*: Germany, 150 tons; Poland, 50 tons. *Muriate of potash*: Germany, 10 tons. *Sulphate of potash*: France, 35 tons; Germany, 110 tons. *Other potash fertilizers*: Belgium, 10 tons; France, 265 tons; Germany, 405 tons. *Sulphate of ammonia*: United Kingdom, 950 tons. *Fertilizers unspecified*: United Kingdom, 519 cwt.; Belgium, 220 cwt.

Correction: In the return for the December quarter, "Other Manures" from the United Kingdom reading 35 tons should read 35 cwt.

—Chemistry Section.

Protective Device against Earwigs and Woodlice (Slaters).—The Orchard Instructor, Blenheim (Mr. D. Hogg) reports: "A good deal of damage has been done among tobacco and tomato seedlings in the boxes by earwigs and slaters, and a local man has invented a box which prevents these insects from reaching the seedlings. The box is 14 in. by 10 in. by 3 in.; a slot is cut in the top edges of the sides and ends, into which a piece of curved tin is fitted, and the insects are unable to crawl round the smooth surface and so fall back on to the ground. I have seen this box demonstrated at one of the local nurseries, and am of the opinion that it would be a valuable acquisition to any one growing seedlings in boxes."

WEATHER RECORDS: APRIL, 1933.

Dominion Meteorological Office.

DURING the first part of April there was a predominance of fine and mild weather, but in the latter half there were frequent boisterous winds from a westerly or south-westerly quarter. An unusually cold spell for the time of year occurred on the 23rd and 24th. Heavy snow fell down to low levels on the ranges, and frosts were numerous and rather severe. It was not until the 28th that mild conditions returned.

Rainfall.—Rainfall was very much below average over the greater part of the North Island. The Hawke's Bay and Poverty Bay districts had less than half. A small area around Hamilton and the country surrounding the South Taranaki Bight, however, recorded more than the normal totals. In the South Island Canterbury was again unfortunate, dry conditions still persisting. Some stations once more experienced a shortage of more than 50 per cent. Over the remainder of the South Island, the rainfall was above the average. A particularly wet month was experienced in Otago and Southland, the normal for April being more than doubled at many places.

Temperature.—Temperatures were slightly above normal over most of the North Island, but the reverse was the case in Taranaki. In the South Island, coastal portions of Marlborough and Canterbury recorded temperatures slightly above normal, but over the remainder they were considerably below. From the 23rd onward there were many frosts, especially in the South Island.

Sunshine.—At most places more than the average amount of bright sunshine was experienced, but in parts of the South Island, especially the west coast and the southern districts, there was a deficit. Napier, with 223.4 hours, had the best record.

Pressure Systems.—During the first part of the month the disturbed conditions experienced in March in the New Caledonia and New Hebrides region persisted with unabated intensity. On the 2nd a deep cyclone, which had developed in the area mentioned and moved southwards, was centred west of Cook Strait. There seemed a prospect of heavy general rains and very stormy conditions, but at this critical stage the cyclone began to fill up and move rapidly south-eastwards. Though strong winds and fairly general rain occurred, the heavy precipitation was confined principally to the mountain ranges and the western and southern portions of the South Island. By the 4th the weather was fine again.

A second deep cyclone developed in the New Hebrides on the 6th, and by the 12th was centred east of Norfolk Island. On the following day, again at the critical stage for New Zealand, it commenced to fill up rapidly, and by the 14th had petered out. It therefore affected only the northern and north-eastern portions of the North Island.

During the 8th and 9th widespread rain was caused by a double westerly depression. The falls were very heavy in the North Island, and many thunderstorms were reported.

The outstanding feature of the month, however, was a very intense anticyclone which covered the whole of Australia, practically continuously, from the 12th to the 26th. Anticyclones of this type are not unusual in the autumn, but seldom occur so early as this. The consequence of this high pressure to the westward was that New Zealand experienced a severe spell of westerly weather. From the 14th to the 27th there was scarcely a day without strong and squally winds from a westerly quarter. They were especially boisterous in the ranges, the night of the 18th to 19th and the 23rd being the roughest periods. On the 23rd a very deep depression crossed the Dominion, and the strong southerly winds which followed it brought a severe cold snap. On this day and the next there was heavy snow in the ranges, and many places experienced hail-showers. The whole period was a very wet one for districts with a westerly aspect.

Thunderstorms occurred in some parts of the country on the 18th, 19th, and 21st to 23rd. A small tornado was reported from near Opotiki on the 22nd.

From the 28th to the 30th finer weather was experienced.

RAINFALL FOR APRIL, 1933, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitia	2·83	12	1·13	4·31
Russell	2·13	7	0·78	4·14
Whangarei	2·99	14	1·01	5·00
Auckland	2·39	16	0·55	3·54
Hamilton	5·75	13	2·72	3·84
Rotorua	3·54	12	1·57	4·53
Kawhia	3·91	14	0·90	4·65
New Plymouth	3·75	17	0·87	4·54
Riversdale, Inglewood	6·54	20	1·86	8·09
Whangamomona	5·70	9	1·50	6·47
Hawera	..	..	..	3·37
Tairua	2·25	10	0·52	5·94
Tauranga	2·39	11	0·99	4·68
Maraehako Station, Opotiki	3·42	10	1·26	4·83
Gisborne	0·33	3	0·19	4·04
Taupo	2·14	13	0·49	3·57
Napier	1·34	5	0·43	2·78
Hastings	0·85	8	0·41	3·32
Whakarara Station	3·32	12	0·81	..
Taihape	3·69	17	0·78	2·79
Masterton	4·23	14	1·45	3·08
Patea	6·68	17	2·20	3·67
Wanganui	3·89	16	0·74	3·28
Foxton	2·61	8	0·71	2·53
Wellington	4·07	11	1·58	3·53
<i>South Island.</i>				
Westport	10·89	21	1·62	8·25
Greymouth	10·23	19	1·44	8·46
Hokitika	11·11	20	1·82	9·29
Ross	18·36	18	3·88	12·03
Arthur's Pass	32·80	21	4·55	15·59
Okuru	21·29	14	7·90	14·14
Collingwood	9·28	13	2·20	8·13
Nelson	3·03	7	1·29	2·99
Spring Creek	2·32	9	0·58	2·09
Hanmer Springs	3·57	14	1·25	3·30
Highfield, Waiau	2·16	7	0·64	2·71
Gore Bay	1·58	8	0·51	2·33
Christchurch	0·75	11	0·23	1·85
Timaru	0·83	9	0·17	1·52
Ladbrook Station, Fairlie	1·66	12	0·45	1·94
Benmore Station, Clearburn	3·70	13	0·70	2·39
Oamaru	1·32	9	0·58	1·76
Queenstown	6·75	19	1·38	2·98
Clyde	2·75	8	0·93	1·42
Dunedin	4·12	17	1·35	2·74
Wendon	5·62	16	1·78	2·67
Gore	6·63	20	1·73	3·12
Invercargill	7·96	24	1·50	4·14
Puysegur Point	10·21	26	1·66	7·75
Half-moon Bay	12·11	25	1·59	5·16

Electrically driven Curd-testing Machines.—Several cheese-factories have installed curd-testing machines driven by an electric motor, and fitted with a brush driven off the spindle for use when washing the test bottles.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

VESSELS FOR BLUESTONE DRENCH.

F. G. HOLT, Waikouaiti :—

For several years I have been dosing my lambs with a mixture of bluestone and iron sulphate, using a benzine-tin for the purpose. Recently I read that a wooden vessel was necessary where bluestone was used. Could you please tell me if it is harmful to the lambs to use a tin?

The Live-stock Division :—

The use of tin in the mixing of bluestone solution is not advisable, as the solution has a corrosive effect on tinware. It is customary, therefore, to recommend porcelain or enamel ware. If the solution requires to be kept for some time before use, porcelain or enamel ware is the best container. On the other hand, if the solution is being used immediately the tin will not be corroded to any extent. The solution, even though mixed in a tin vessel, is not harmful to lambs. To prevent any chemical change occurring in the solution, however, it is more satisfactory to use vessels as recommended above.

LIME AND NITROGENOUS MANURES.

A. B. G., Wairoa :—

Kindly tell me whether any harm results from mixing lime and guano. I have been making a mixture of North African and Nauru phosphates, guano, super, and lime.

The Fields Division :—

Lime should not be mixed with any manure—artificial or otherwise—which contains nitrogen, as it releases the latter on contact in the form of ammonia. Present-day so-called guanos are usually very low in nitrogen, but nevertheless lime would set free the nitrogen content, and for the same reason animal manures should never be mixed with lime.

CONTROLLING PASPALUM IN LAWN.

S. M. PALMER, Havelock North :—

Can you suggest any control for paspalum in a lawn?

The Horticulture Division :—

The best treatment for controlling paspalum in a lawn is to weed it out in autumn, then sow what grass-seeds may be necessary, and apply a light top-dressing. An alternative treatment is returfing, and if fairly large areas are affected this may be desirable.

BARLEY GRAIN AS SHEEP FEED.

W. ADAMS, Hawarden :—

Kindly advise me if barley grain is suitable for sheep-feed in the winter-time, and in what quantity. Would it need crushing, or soaking in water?

The Live-stock Division :—

Barley, except as green feed, is seldom used in this country as sheep-feed, but is extensively used with excellent results in some parts of America. The grains should be bruised (*not* finely crushed) and mixed with chaff. Hay should be fed, preferably legume hay; with this, barley gives the best results. Commencing with $\frac{1}{2}$ lb. per sheep per day, the amount may be increased to 1 lb. per day.

HEIFER WITH WART-LIKE GROWTHS.

"FARMER," Gisborne :—

I have a two-year-old heifer which came in with its face, neck, and shoulders almost covered with warts. In places it looks like barnacles. The heifer has milked well all the season, but is in poor condition, although on good feed. I should be glad of your advice.

The Live-stock Division :—

The smaller wart-like growths on the heifer may be removed with a pair of sharp scissors or simply by pressure between the finger and thumb. The larger growths will require to be removed by using elastic ligatures or by the use of a hot-iron to prevent unnecessary hæmorrhage. The poor condition is in all probability due to the animal being a good milker, and seldom if ever could loss of condition be attributed to growths of this nature. The growths are not considered malignant and seldom do much harm. They are, of course, objectionable to look at in a dairy cow.

FORAGE CROP FOR ENSILAGE.

A. D. M., Waipawa :—

It is my intention to sow oats for ensilage, but I wish to include some legume with the crop to give it a better balance and also to enrich the nitrogen content of the soil, which is of a very light nature. It was my intention to use tares with the oats, but they are almost unprocurable here other than at a prohibitive price. Please advice whether it would be practicable to include lupins with the oats.

The Fields Division :—

We suggest that you use partridge peas in the proportion of 1 to 1½ bushels of peas to 2 bushels of oats per acre. Although lupins have been grown as a fodder, it is considered that peas are more palatable and will add nitrogen to the soil in a similar manner.

MAMMITIS AND DRINKING-TROUGHS.

J. J., Manurewa :—

Kindly inform me whether cows suffering from mammitis are likely to infect their drinking-water? Would a common drinking-trough, used by stock in two paddocks, be a source of danger if the cows in one of the paddocks were infected?

The Live-stock Division :—

It is hardly possible for the drinking-water to be infected in the way mentioned. We do not consider that there is any danger in the use of a common trough supplying two lots of cows, one lot being affected animals.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 9th March to 4th May, 1933, include the following of agricultural interest :—

No. 68402 : Harrow ; E. C. Frost. No. 68802 : Milking-machine pulsator ; A. C. Jolly. No. 68871 : Packing eggs ; A. Cole. No. 69178 : Gardening implements ; J. Notman. No. 69922 : Harrow ; G. V. Keenan and J. A. C. Keenan. No. 68047 : Chicken-brooder ; G. J. Herring. No. 68267 : Manure-sowing machine ; J. Rollo and G. S. Millar. No. 68504 : Teat-cup ; H. H. Johnson and J. F. Johnson. No. 68866 : Cattle controller ; H. V. Dyke. No. 69067 : Docking instrument ; C. A. Mowat. No. 69723 : Butter packing ; A. B. Abel. No. 67706 : Fruit grading ; S. H. Higgs. No. 69303 : Cultivator ; E. Read. No. 69633 : Pulsator and releaser ; Gordon Vacuum Break Milkers, Ltd. No. 69845 : Manure-distributor ; Imperial Chemical Industries, Ltd. No. 69926 : Cultivator ; E. J. Thompson.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.